Karlsruher Institut für Technologie

Module Handbook
Master Program Mechanical Engineering (M.Sc.)

SPO 2016, for study beginners from summer term 2019

Valid from Winter Term 2019/2020

Date: 11.09.2019

KIT DEPARTMENT OF MECHANICAL ENGINEERING

Table Of Contents

1 About this handbook

1.1 Notes and rules

The program exists of several **subjects** (e.g. Fundamentals of Engineering). Every subject is split into **modules** and every module itself consists of one or more interrelated **module component exams**. The extent of every module is indicated by credit points (CP), which will be credited after the successful completion of the module. Some of the modules are **obligatory**. According to the interdisciplinary character of the program, a great variety of **individual specialization and deepening possibilities** exists for a large number of modules. This enables the student to customize content and time schedule of the program according to personal needs, interest and job perspective. The **module handbook** describes the modules belonging to the program. It describes particularly:

- the structure of the modules
- the extent (in CP),
- the dependencies of the modules,
- the learning outcomes,
- the assessment and examinations.

The module handbook serves as a necessary orientation and as a helpful guide throughout the studies. The module handbook does not replace the **course catalog**, which provides important information concerning each semester and variable course details (e.g. time and location of the course).

1.1.1 Begin and completion of a module

Each module and each examination can only be selected once. The decision on the assignment of an examination to a module (if, for example, an examination in several modules is selectable) is made by the student at the moment when he / she is registered for the appropriate examination. A module is completed or passed when the module examination is passed (grade 4.0 or better). For modules in which the module examination is carried out over several partial examinations, the following applies: The module is completed when all necessary module partial examinations have been passed. In the case of modules which offer alternative partial examinations, the module examination is concluded with the examination with which the required total credit points are reached or exceeded. The module grade, however, is combined with the weight of the predefined credit points for the module in the overall grade calculation.

1.1.2 Module versions

It is not uncommon for modules to be revised due to, for example, new courses or cancelled examinations. As a rule, a new module version is created, which applies to all students who are new to the module. On the other hand, students who have already started the module enjoy confidence and remain in the old module version. These students can complete the module on the same conditions as at the beginning of the module (exceptions are regulated by the examination committee). The date of the student's "`binding declaration"' on the choice of the module in the sense of �5(2) of the Study and Examination Regulation is decisive. This binding declaration is made by registering for the first examination in this module.

In the module handbook, all modules are presented in their current version. The version number is given in the module description. Older module versions can be accessed via the previous module handbooks in the archive.

1.1.3 General and partial examinations

Module examinations can be either taken in a general examination or in partial examinations. If the module examination is offered as a general examination, the entire learning content of the module will be examined in a single examamination. If the module examination is subdivided into partial examinations, the content of each course will be examined in corresponding partial examinations. Registration for examinations can be done online at the campus management portal. The following functions can be accessed on https://campus.studium.kit.edu/:

- Register/unregister for examinations
- Check for examination results
- Create transcript of records

For further and more detailed information, https://studium.kit.edu/Seiten/FAQ.aspx.

1.1.4 Types of exams

Exams are split into written exams, oral exams and alternative exam assessments. Exams are always graded. Non exam assessments can be repeated several times and are not graded.

1.1.5 Repeating exams

Principally, a failed written exam, oral exam or alternative exam assessment can repeated only once. If the repeat examination (including an eventually provided verbal repeat examination) will be failed as well, the examination claim is lost. A request for a second repetition has to be made in written form to the examination committee two months after loosing the examination claim.

1.1.6 Additional accomplishments

Additional accomplishments are voluntarily taken exams, which have no impact on the overall grade of the student and can take place on the level of single courses or on entire modules. It is also mandatory to declare an additional accomplishment as such at the time of registration for an exam.

1.1.7 Further information

More detailed information about the legal and general conditions of the program can be found in the examination regulation of the program (**http://www.sle.kit.edu/amtlicheBekanntmachungen.php**).

Studienplan der KIT-Fakultät für Maschinenbau für den Masterstudiengang Maschinenbau gemäß SPO 2015

Fassung vom 30. August 2019

Inhaltsverzeichnis

0 Abkürzungsverzeichnis

Vertiefungsrichtungen:	MB	Allgemeiner Maschinenbau
	E+U	Energie- und Umwelttechnik
	FzgT	Fahrzeugtechnik
	M+M	Mechatronik und Mikrosystemtechnik
	PEK	Produktentwicklung und Konstruktion
	PT	Produktionstechnik
	ThM	Theoretischer Maschinenbau
	W+S	Werkstoffe und Strukturen für Hochleistungssysteme
Semester:	WS	Wintersemester
	SS	Sommersemester
Schwerpunkte:	K, KP	Teilleistung im Kernbereich, ggf. Pflicht des Schwerpunkts
	E	Teilleistung im Ergänzungsbereich des Schwerpunkts
	EM	Teilleistung im Ergänzungsbereich ist nur im Masterstudiengang wählbar
Lehrveranstaltung:	V	Vorlesung
	Ü	Übung
	P	Praktikum
	SWS	Semesterwochenstunden
Teilleistung:	LP	Leistungspunkte
	Pr	Prüfung
	Pr (h)	Prüfungsdauer in Stunden
	mPr	mündliche Prüfung
	sPr	schriftliche Prüfung
	PraA	Prüfungsleistung anderer Art
	Schein	unbenotete Modulleistung
	TL	Teilleistung
	Gew	Gewichtung einer Prüfungsleistung im Modul bzw. in der Gesamtnote
Sonstiges:	SPO	Studien- und Prüfungsordnung
	w	wählbar
	p	verpflichtend

1 Studienpläne, Module und Prüfungen

Das Masterstudium kann sowohl zum Winter- als auch zum Sommersemester aufgenommen werden. Wegen der freien Wahl der Module lässt sich für das Masterstudium kein exemplarischer Studienverlauf angeben.

Die Angabe der Leistungspunkte (LP) erfolgt gemäß dem „European Credit Transfer and Accumulation System“ (ECTS) und basiert auf dem von den Studierenden zu absolvierenden Arbeitspensum.

1.1 Prüfungsmodalitäten

In jedem Semester wird für Prüfungen mindestens ein Prüfungstermin angeboten. Prüfungstermine sowie Termine, zu denen die Anmeldung zu den Prüfungen spätestens erfolgen muss, werden vom Prüfungsausschuss festgelegt. Die Anmeldung für die Prüfungen erfolgt in der Regel mindestens eine Woche vor der Prüfung. Anmelde- und Prüfungstermine werden rechtzeitig bekanntgegeben, bei schriftlichen Prüfungen mindestens 6 Wochen vor der Prüfung.

Über Hilfsmittel, die bei einer Prüfung benutzt werden dürfen, entscheidet der Prüfer. Eine Liste der zugelassenen Hilfsmittel wird gleichzeitig mit der Ankündigung des Prüfungstermins bekanntgegeben.

Studienleistungen/Scheine können solange beliebig oft wiederholt werden, bis diese erfolgreich absolviert wurden.

1.2 Vertiefungsrichtungen

Es stehen folgende Vertiefungsrichtungen zur Auswahl:

Vertiefungsrichtung	Abk.	Verantwortlicher
Allgemeiner Maschinenbau	MB	Furmans
Energie- und Umwelttechnik	E+U	Maas
Fahrzeugtechnik	FzgT	Gauterin
Mechatronik und Mikrosystemtechnik	M+M	Korvink
Produktentwicklung und Konstruktion	PEK	Albers
Produktionstechnik	PT	Schulze
Theoretischer Maschinenbau	ThM	Böhlke
Werkstoffe und Strukturen für Hochleistungssysteme	W+S	Heilmaier

Die Wahlmöglichkeiten im Wahlpflichtmodul „Grundlagen und Methoden der Vertiefungsrichtung“ und in den Schwerpunkten richten sich nach der gewählten Vertiefungsrichtung. Die zur Verfügung stehenden Module der Vertiefungsrichtungen werden im Modulhandbuch aufgeführt. Schriftliche Prüfungen werden als Klausuren mit der angegebenen Prüfungsdauer in Stunden abgenommen. Prüfungsleistungen gehen mit dem angegebenen Gewicht (Gew) in die Gesamtnote ein.

Folgende Module sind im Masterstudiengang zu belegen:

Fach	Modul	LP/ Modul	Teilleistung	LP	Koordina-tor	Art der Erfolgs-kontrolle	Pr (h)	Gew
Vertiefung ingenieurwissenschaftlicher Grundlagen	Produktentstehung - Bauteildimensionie-rung	7	Produktentstehung - Bauteildimensionie-rung	7	Schulze	sPr	2	7
	Produktentstehung - Entwicklungsmetho-dik	6	Methoden und Pro-zesse der PGE - Produktgenerations-entwicklung	6	Matthiesen, Albers	sPr	2	6
	Modellbildung und Simulation	7	Modellbildung und Simulation	7	Proppe	sPr	3	7
	Mathematische Methoden	6	wählbare TL s. Mo-dulhandbuch	6	Heilmaier	sPr	3[1]	6
	Laborpraktikum	4	wählbare TL s. Mo-dulhandbuch	4	Stiller, Furmans	Schein		
	Wahlpflichtmodul Maschinenbau	8	Teilleistung 1, wähl-bare TL s. Modul-handbuch	4	Heilmaier	mPr	ca. 0,4	4
			Teilleistung 2, wähl-bare TL s. Modul-handbuch	4	Heilmaier	mPr	ca. 0,4	4
	Wahlpflichtmodul nat/inf/etit	6	wählbare TL s. Mo-dulhandbuch	6	Maas	Schein		
	Wahlpflichtmodul wirt/recht	4	wählbare TL s. Mo-dulhandbuch	4	Furmans	Schein		
	Schlüssel-qualifikationen	2	wählbare TL von HoC, ZAK bzw. Mo-dulhandbuch	2		Schein		
Vertiefungsrichtung	Schwerpunkt 1	16	Kern-/Ergänzungs-bereich, wählbare TL s. Modulhand-buch	16	SP-Verant-wortlicher	mPr	ca. 2x0,7 bzw. ca. 4x0,4	16
	Schwerpunkt 2	16	Kern-/Ergänzungs-bereich, wählbare TL s. Modulhand-buch	16	SP-Verant-wortlicher	mPr	ca. 2x0,7 bzw. ca. 4x0,4	16
	Grundlagen und Methoden der Ver-tiefungsrichtung	8	Teilleistung 1, wähl-bare TL s. Modul-handbuch	4	Heilmaier	mPr, sPr	ca. 0,4 bzw. 1,5 - 3,0	4
			Teilleistung 2, wähl-bare TL s. Modul-handbuch	4	Heilmaier	mPr, sPr	ca. 0,4 bzw. 1,5 – 3,0	4
Masterarbeit	Masterarbeit	30	Masterarbeit und Präsentation	30		PraA		30

[1] Bei der Veranstaltung „Wahrscheinlichkeitstheorie und Statistik" beträgt die Prüfungsdauer abweichend 1,5 h.

2 Zugelassene Teilleistungen in den Wahlpflichtmodulen

Jedes Fach, jedes Modul und jede Teilleistung kann nur einmal im Rahmen des Bachelorstudienganges und des konsekutiven Masterstudiengangs Maschinenbau gewählt werden.

2.1 Wahlpflichtmodul Grundlagen und Methoden der Vertiefungsrichtung

Im Masterstudiengang müssen zwei Teilleistungen mit jeweils 4 LP im Modul Grundlagen und Methoden der jeweiligen Vertiefungsrichtung erbracht werden. Wählbare Teilleistungen siehe Modulhandbuch

2.2 Mathematische Methoden

Wählbare Teilleistungen siehe Modulhandbuch.

2.3 Wahlpflichtmodul aus dem Bereich Naturwissenschaften/Informatik/Elektrotechnik

Wählbare Teilleistungen siehe Modulhandbuch. Der Wechsel der gewählten Teilleistung ist bis zum Bestehen der Erfolgskontrolle möglich. Andere Teilleistungen, auch aus anderen Fakultäten, können mit Genehmigung des Prüfungsausschusses gewählt werden.

2.4 Wahlpflichtmodul aus dem Bereich Wirtschaft/Recht

Wählbare Teilleistungen siehe Modulhandbuch. Der Wechsel der gewählten Teilleistung ist bis zum Bestehen der Erfolgskontrolle möglich. Andere Teilleistungen, auch aus anderen Fakultäten, können mit Genehmigung des Prüfungsausschusses gewählt werden.

2.5 Wahlpflichtmodul aus dem Bereich Maschinenbau

Wählbare Teilleistungen siehe Modulhandbuch. Andere Teilleistungen, auch aus anderen Fakultäten, können mit Genehmigung des Prüfungsausschusses gewählt werden.

2.6 Laborpraktikum

Wählbare Teilleistungen siehe Modulhandbuch. Der Wechsel der gewählten Teilleistung ist bis zum Bestehen der Erfolgskontrolle möglich.

3 Schwerpunkte

Generell gilt, dass jede Teilleistung und jeder Schwerpunkt nur einmal entweder im Rahmen des Bachelorstudienganges und des konsekutiven Masterstudiengangs Maschinenbau gewählt werden kann.

3.1 Zuordnung der Schwerpunkte zu den Vertiefungsrichtungen

Folgende Schwerpunkte sind derzeit vom Fakultätsrat genehmigt. In einigen Vertiefungsrichtungen ist die Wahl des **ersten** Schwerpunkts eingeschränkt (einer der mit „p“ gekennzeichneten Schwerpunkte ist zu wählen).
In einem konsekutiven Masterstudium kann der erste Masterschwerpunkt auch als w-Schwerpunkt gewählt werden, wenn ein p-Schwerpunkt dieser Vertiefungsrichtung bereits im Bachelorstudium gewählt wurde.

Schwerpunkt	SP-Verant-wortlicher	SP-Nr.	MB	E+U	FzgT	M+M	PEK	PT	ThM	W+S
Advanced Materials Modelling	Böhlke	56	w						w	w
Advanced Mechatronics	Mikut	1	w	w	w	p	w	w	w	
Angewandte Mechanik	Böhlke	30	w	w	w	w	w	w	p	w
Antriebssysteme	Albers	2	w		w		w	w		
Automatisierungstechnik	Mikut	4	w	w	w	p	w	w	w	
Bahnsystemtechnik	Gratzfeld	50	w		p	w	w			
Computational Mechanics	Proppe	6	w		w	w	w		p	
Entwicklung innovativer Geräte	Matthiesen	51	w	w	w		p	w		
Entwicklung und Konstruktion	Albers	10	w	w	w		w	w		
Fahrdynamik, Fahrzeugkomfort und -akustik	Gauterin	11	w		w	w	w		w	
Fusionstechnologie	Stieglitz	53	w	w					w	
Gebäudeenergietechnik	H.-M. Henning	55	w	w						
Grundlagen der Energietechnik	Bauer	15	w	p	w	w	w			
Informationstechnik	Stiller	18	w	w	w	w	w	w	w	
Informationstechnik für Logistiksysteme	Furmans	19	w				w	w		
Innovation und Entrepreneurship	Class	59		w						
Integrierte Produktentwicklung	Albers	20	w	w	w		p	w		
Kerntechnik	Cheng	21	w	w					w	
Kognitive Technische Systeme	Stiller	22	w		w	w	w	w	w	
Kraftfahrzeugtechnik	Gauterin	12	w		p		w			
Kraft- und Arbeitsmaschinen	Th. Koch	24	w	w	w		w			
Kraftwerkstechnik	Bauer	23	w	w			w			
Leichtbau	F. Henning	25	w	w	w		w	w		w
Lifecycle Engineering	Ovtcharova	28	w		w	w	p	p		
Logistik und Materialflusslehre	Furmans	29	w				w	p		
Materialwissenschaft und Werkstofftechnik	Heilmaier	26	w	w	w	w	w	w	w	p
Mechatronik	Hagen-meyer	31	w	w	w	p	w	w	w	
Medizintechnik	Pylatiuk	32	w			w	w			
Mensch - Technik - Organisation	Deml	3	w	w			w	p		
Mikroaktoren und Mikrosensoren	Kohl	54	w	w	w	w	w	w		
Mikrosystemtechnik	Korvink	33	w	w	w	p	w	w		
Mobile Arbeitsmaschinen	Geimer	34	w		p	w	w	w		
Modellbildung und Simulation in der Dynamik	Seemann	61	w	w	w	w	w	w	p	
Modellierung und Simulation in der Energie- und Strömungs-technik	Maas	27	w	w	w	w	w			
Polymerengineering	Elsner	36	w	w	w		w	w		w
Produktionstechnik	Schulze	39	w		w		w	p		

Studienplan für den Masterstudiengang Maschinenbau gem. SPO 2015. Gültig ab 01.10.2019, auf Beschlussfassung des Fakultätsrats vom 08.05.2019, mit redaktionellen Änderungen vom 30.08.2019. Seite 6 von 9

Schwerpunkt	SP-Verant-wortlicher	SP-Nr.	MB	E+U	FzgT	M+M	PEK	PT	ThM	W+S
Robotik	Mikut	40	w			p	w	w	w	
Schwingungslehre	Fidlin	60	w	w	w	w	w	w	p	
Strömungsmechanik	Frohnapfel	41	w	w	w		w		p	
Technische Keramik und Pulverwerkstoffe	Hoffmann	43	w	w	w		w			w
Technische Logistik	Furmans	44	w				w	w		
Technische Thermodynamik	Maas	45	w	w	w	w	w		w	w
Thermische Turbomaschinen	Bauer	46	w	w	w				w	w
Tribologie	Dienwiebel	47	w	w	w	w	w	w	w	w
Verbrennungsmotorische Antriebssysteme	Th. Koch	58	w	w	p	w	w			
Zuverlässigkeit im Maschinenbau	Gumbsch	49	w	w	w	w	w	w	w	p

Für jeden Schwerpunkt werden Teilleistungen im Umfang von 16 LP gewählt, davon werden mindestens 8 LP im Kernbereich (K) erworben. „KP“ bedeutet, dass die Lehrveranstaltung im Kernbereich Pflicht ist, sofern sie nicht bereits belegt wurde. Die übrigen 8 LP können aus dem Ergänzungsbereich kommen. Dabei dürfen im Rahmen von Praktika höchstens 4 LP erworben werden, die auch als Studienleistung erbracht werden können.

Die im Ergänzungsbereich (E) angegebenen Teilleistungen verstehen sich als Empfehlung, andere Teilleistungen (auch aus anderen KIT-Fakultäten) können mit Genehmigung des jeweiligen Schwerpunkt-verantwortlichen gewählt werden. Dabei ist eine Kombination mit Teilleistungen aus den Bereichen Informatik, Elektrotechnik und Mathematik in einigen Vertiefungsrichtungen besonders willkommen.

Ein Absolvieren des Schwerpunktmoduls mit mehr als 16 LP ist nur im Fall, dass die Addition innerhalb des Schwerpunktmoduls nicht auf 16 LP aufgeht, erlaubt. Nicht zulässig ist es jedoch, noch weitere Teilleistungen anzumelden, wenn bereits 16 LP erreicht oder überschritten wurden.

Für die Prüfungsleistungen in den Schwerpunkten gelten folgende Regeln:
Die Prüfungen werden grundsätzlich mündlich abgenommen, bei unvertretbar hohem Prüfungsaufwand kann eine mündlich durchzuführende Prüfung auch schriftlich abgenommen werden. Es wird empfohlen, die Kernbereichsprüfung im Block abzulegen. Bei mündlichen Prüfungen im Schwerpunkt soll die Prüfungsdauer fünf Minuten pro Leistungspunkt betragen. Erstreckt sich eine mündliche Prüfung über mehr als 12 LP, soll die Prüfungsdauer 60 Minuten betragen.

Die Bildung der Schwerpunktnote erfolgt anhand der mit einer Prüfungsleistung abgeschlossenen Teilleistungen. Dabei werden alle Teilleistungen gemäß ihrer Leistungspunkte gewichtet. Bei der Bildung der Gesamtnote wird der Schwerpunkt mit 16 LP gewertet.

Die Beschreibung der Schwerpunkte hinsichtlich der jeweils darin enthaltenen Teilleistungen und den damit verbundenen Lehrveranstaltungen ist im aktuellen Modulhandbuch des Masterstudiengangs festgelegt.

4 Masterarbeit

Für die Betreuung der Masterarbeit stehen je nach Vertiefungsrichtung folgende Institute (●) zur Wahl:

Institut für	Abk.	MB	E+UT	FzgT	M+M	PEK	PT	ThM	W+S
Angewandte Werkstoffphysik	IAM-AWP	●	●	●	●	●	–	●	●
Angewandte Thermofluidik	IATF	●	●	–	–	–	–	–	–
Automation und angewandte Informatik	IAI	●	●	●	●	●	●	●	●
Arbeitswissenschaft und Betriebsorganisation	ifab	●	●	●	–	●	●	–	–
Computational Materials Science	IAM-CMS	●	●	●	●	●	–	●	●
Fahrzeugsystemtechnik	FAST	●	●	●	●	●	–	●	●
Fördertechnik und Logistiksysteme	IFL	●	–	–	–	●	●	●	–
Informationsmanagement im Ingenieurwesen	IMI	●	–	●	●	●	●	–	–
Keramische Werkstoffe und Technologien	IAM-KWT	●	●	–	–	●	–	–	●
Kern- und Energietechnik	IKET	●	●	–	–	–	–	–	–
Kolbenmaschinen	IFKM	●	●	●	–	●	–	–	–
Mess- und Regelungstechnik	MRT	●	●	●	●	●	–	●	–
Mikrostrukturtechnik	IMT	●	●	●	●	●	●	–	–
Produktentwicklung	IPEK	●	●	●	●	●	●	–	●
Produktionstechnik	WBK	●	–	●	●	●	●	–	●
Strömungsmechanik	ISTM	●	●	●	●	●	–	●	–
Technische Mechanik	ITM	●	●	●	●	●	●	●	●
Thermische Strömungsmaschinen	IST	●	●	●	–	●	–	●	●
Technische Thermodynamik	ITT	●	●	●	–	–	–	●	–
Werkstoff- und Biomechanik	IAM-WBM	●	●	●	●	●	●	●	●
Werkstoffkunde	IAM-WK	●	●	●	●	●	●	●	●

In interdisziplinär ausgerichteten Vertiefungsrichtungen ist die Beteiligung von Instituten anderer Fakultäten erwünscht. Mit Zustimmung der Vertiefungsrichtungsverantwortlichen kann der Prüfungsausschuss auch Masterarbeiten an anderen Instituten der Fakultät für Maschinenbau genehmigen. Zustimmung und Genehmigung sind vor Beginn der Arbeit einzuholen.

5 Änderungshistorie (ab 22.04.2015)

07.11.2016	redaktionelle Anpassung der TL-Namen in 2.1
28.06.2017	redaktionelle Anpassungen
13.07.2018	Anpassung der Schwerpunkte sowie redaktionelle Änderungen
08.05.2019	Änderung Punkt 2.1
30.08.2019	redaktionelle Änderungen in Punkt 1.2 und 4

WS 2019-2020	M.Sc. Maschinenbau: Pflichtmodule; WPM Nat/inf/etit; WPM Wirtschaft/Recht; MM				
Zeit	**Montag**	**Dienstag**	**Mittwoch**	**Donnerstag**	**Freitag**
08:00 – 09:30	2181612 Physikalische GL der Lasertechnik (+Üb) Grashof 2117059 Math. Modelle u. Methoden für Produktions-systeme 50.38 R 0.22	2302111 Signale und Systeme (Üb) Gaede 2161207 MM der Dynamik (Üb) Grashof		2185227 Modellbildung und Simulation Audimax	2302109 Signale und Systeme Tulla HS
09:45 – 11:15	2149667 Qualitäts-management HS a.F. 2311607 Systems and Software Engin. (Üb) NTI	2161254 MM der Kontinuumsmechanik 10.50 Großer HS			2153429 Magnetohydrodynamik 10.50 R 602
11:30 – 13:00	2311620 Hardware/Software Co-Design MTI		2302113 Meth. der Signal-verarbeitung 11.10 EAS 2109036 Arbeitswissenschaft II: Arbeitsorganisation Redt.	2153406 Ström. mit chemischen Reaktionen 10.81 HS 59 2302115 Meth. der Signalverar-beitung (Üb) 30.41 HS 2 2109036 Arbeitswissen-schaft II: Arbeits-organisation Redt.	2311605 Systems and Software Engineering MTI
13:00 - 14:00					
14:00 – 15.30					2161206 MM der Dynamik Grashof
15:45 – 17:15	2185228 Modellbildung und Simulation (Üb) HS a. F.	2311623 Hardware/Software Co-Design (Üb) NTI	2181612 Phys. GL der Lasertechnik (+Üb) Redt.	24016 Öffentliches Recht I - Grundlagen 50.34 R -101	2161255 MM der Kontinuumsmechanik (Üb) 10.50 Kl. HS
17:30 – 19:00					

Stand: 06.09.2019

(Pflicht-) Vorlesung | MM / Wahlfach WR | Wahlfach NIE | Übung

2185228 Modellbildung und Simulation (Üb) weitere Termine s. Vorlesungsverzeichnis	2145184 Leadership and Management Development

WS 2019-2020	M.Sc. Maschinenbau: Pflichtmodule; Grundlagen und Methoden				
Zeit	**Montag**	**Dienstag**	**Mittwoch**	**Donnerstag**	**Freitag**
08:00 - 09:30	2181612 Phys. GL der Laser-technik (+Üb) Grashof 2114093 Fluid-technik Gaede 2117059 Mathem. Modelle und Methoden für Prod.-systeme 50.38 R 0.22	2161207 MM der Dynamik (Üb) Grashof 2165515 GL der tech. Verbrennung I 30.41 HS 3 2105011 Einführung in die Mechatronik (14-tägl.) Hertz		2185227 Modellbildung und Simulation Audimax	2105011 Einführung in die Mechatronik Hertz 2141865 Neue Aktoren und Sensoren Redt.
09:45 - 11:15		2161254 MM der Kontinuumsmechanik 10.50 Großer HS		2181739 Wiss. Programmieren f. Ing. (Üb) 20.21 SCC-PC-Pool H	2183702 Mikrostruktur-simulation (+Üb) Oberer HS 2165513 Wärme- und Stoffübertragung (Üb) Grashof
11:30 - 13:00	2114088 Fluidtechnik (Üb) 30.41 HS 3 2133123 Techn. GL des Verbrennungsmotors 10.50 Kl. HS	2183703 Modellierung und Simulation HsKA, AM001, Amalienstr. 81-87	2109035 Arbeitswissen-schaft I: Ergonomie Redt. 2183702 Mikrostr.-simulation (+Üb) (14-tägl.) 30.48 R 017	2109035 Arbeitswissenschaft I: Ergonomie Redt.	
13:00 - 14:00					
14:00 - 15:30	2121350 PLM HS I Chemie	2117095 GL der technischen Logistik (+Üb) Gaede	2161213 Techn. Schwingungs-lehre (Üb) Tulla 2181738 Wiss. Program-mieren für Ingenieure Grashof	2141861 GL Mikrosystemtechnik I Grashof	2161206 MM der Dynamik Grashof 2181739 Wiss. Programmieren für Ingenieure (Üb) 20.21 SCC-PC-Pool A
15:45 - 17:15	2185228 Modellbildung und Simulation (Üb) HS a.F.		2117095 GL der technischen Logistik (+Üb) Tulla 2181612 Phys. GL der Lasertechnik (+Üb) Redt.	2181739 Wiss. Prog-rammieren f. Ing. (Üb) 20.21 SCC-PC-Pool A 2161212 Techn. Schw.-Lehre MTI 2165512 Wärme- und Stoff-übertragung Nusselt	2161255 MM der Kontinuumsmechanik (Üb) 10.50 Kl. HS
17:30 - 19:00	2183703 Modellierung und Simulation (bis 20:00 Uhr) 20.29 Pool C				

Stand: 06.09.2019

Pflichtfach | Übung | Wahlpflichtfach

2185228 Modellbildung und Simulation (Üb) weitere Termine s. Vorlesungsverzeichnis

Universität des Landes Baden-Württemberg und
nationales Forschungszentrum in der Helmholtz-Gemeinschaft

Amtliche Bekanntmachung

2015 **Ausgegeben Karlsruhe, den 06. August 2015** **Nr. 61**

I n h a l t **Seite**

Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Maschinenbau

vom 04. August 2015

Aufgrund von § 10 Absatz 2 Ziff. 5 und § 20 des Gesetzes über das Karlsruher Institut für Technologie (KIT-Gesetz - KITG) in der Fassung vom 14. Juli 2009 (GBl. S. 317 f), zuletzt geändert durch Artikel 5 des Dritten Gesetzes zur Änderung hochschulrechtlicher Vorschriften (3. Hochschulrechtsänderungsgesetz – 3. HRÄG) vom 01. April 2014 (GBl. S. 99, 167) und § 8 Absatz 5 des Gesetzes über die Hochschulen in Baden-Württemberg (Landeshochschulgesetz - LHG) in der Fassung vom 1. Januar 2005 (GBl. S. 1 f), zuletzt geändert durch Artikel 1 des 3. HRÄG vom 01. April 2014 (GBl. S. 99 ff.), hat der Senat des KIT am 20. Juli 2015 die folgende Studien- und Prüfungsordnung für den Masterstudiengang Maschinenbau beschlossen.

Der Präsident hat seine Zustimmung gemäß § 20 Absatz 2 KITG iVm. § 32 Absatz 3 Satz 1 LHG am 04. August 2015 erteilt.

Inhaltsverzeichnis

Präambel

Das KIT hat sich im Rahmen der Umsetzung des Bolognaprozesses zum Aufbau eines Europäischen Hochschulraumes zum Ziel gesetzt, dass am Abschluss des Studiums am KIT der Mastergrad stehen soll. Das KIT sieht daher die am KIT angebotenen konsekutiven Bachelor- und Masterstudiengänge als Gesamtkonzept mit konsekutivem Curriculum.

I. Allgemeine Bestimmungen

§ 1 Geltungsbereich

Diese Masterprüfungsordnung regelt Studienablauf, Prüfungen und den Abschluss des Studiums im Masterstudiengang Maschinenbau am KIT.

§ 2 Ziel des Studiums, Akademischer Grad

(1) Im konsekutiven Masterstudium sollen die im Bachelorstudium erworbenen wissenschaftlichen Qualifikationen weiter vertieft, verbreitert, erweitert oder ergänzt werden. Ziel des Studiums ist die Fähigkeit, die wissenschaftlichen Erkenntnisse und Methoden selbstständig anzuwenden und ihre Bedeutung und Reichweite für die Lösung komplexer wissenschaftlicher und gesellschaftlicher Problemstellungen zu bewerten.

(2) Aufgrund der bestandenen Masterprüfung wird der akademische Grad „Master of Science (M.Sc.)“ für den Masterstudiengang Maschinenbau verliehen.

§ 3 Regelstudienzeit, Studienaufbau, Leistungspunkte

(1) Die Regelstudienzeit beträgt vier Semester.

(2) Das Lehrangebot des Studiengangs ist in Fächer, die Fächer sind in Module, die jeweiligen Module in Lehrveranstaltungen gegliedert. Die Fächer und ihr Umfang werden in § 19 festgelegt. Näheres beschreibt das Modulhandbuch.

(3) Der für das Absolvieren von Lehrveranstaltungen und Modulen vorgesehene Arbeitsaufwand wird in Leistungspunkten (LP) ausgewiesen. Die Maßstäbe für die Zuordnung von Leistungspunkten entsprechen dem European Credit Transfer System (ECTS). Ein Leistungspunkt entspricht einem Arbeitsaufwand von etwa 30 Zeitstunden. Die Verteilung der Leistungspunkte auf die Semester hat in der Regel gleichmäßig zu erfolgen.

(4) Der Umfang der für den erfolgreichen Abschluss des Studiums erforderlichen Studien- und Prüfungsleistungen wird in Leistungspunkten gemessen und beträgt insgesamt 120 Leistungspunkte.

(5) Lehrveranstaltungen können nach vorheriger Ankündigung auch in englischer Sprache angeboten werden, sofern es deutschsprachige Wahlmöglichkeiten gibt.

§ 4 Modulprüfungen, Studien- und Prüfungsleistungen

(1) Die Masterprüfung besteht aus Modulprüfungen. Modulprüfungen bestehen aus einer oder mehreren Erfolgskontrollen.

Erfolgskontrollen gliedern sich in Studien- oder Prüfungsleistungen.

(2) Prüfungsleistungen sind:

1. schriftliche Prüfungen,
2. mündliche Prüfungen oder
3. Prüfungsleistungen anderer Art.

(3) Studienleistungen sind schriftliche, mündliche oder praktische Leistungen, die von den Studierenden in der Regel lehrveranstaltungsbegleitend erbracht werden. Die Masterprüfung darf nicht mit einer Studienleistung abgeschlossen werden.

(4) Von den Modulprüfungen sollen mindestens 70 % benotet sein.

(5) Bei sich ergänzenden Inhalten können die Modulprüfungen mehrerer Module durch eine auch modulübergreifende Prüfungsleistung (Absatz 2 Nr.1 bis 3) ersetzt werden.

§ 5 Anmeldung und Zulassung zu den Modulprüfungen und Lehrveranstaltungen

(1) Um an den Modulprüfungen teilnehmen zu können, müssen sich die Studierenden online im Studierendenportal zu den jeweiligen Erfolgskontrollen anmelden. In Ausnahmefällen kann eine Anmeldung schriftlich im Studierendenservice oder in einer anderen vom Studierendenservice autorisierten Einrichtung erfolgen. Für die Erfolgskontrollen können durch die Prüfenden Anmeldefristen festgelegt werden. Die Anmeldung der Masterarbeit ist im Modulhandbuch geregelt.

(2) Sofern Wahlmöglichkeiten bestehen, müssen Studierende, um zu einer Prüfung in einem bestimmten Modul zugelassen zu werden, vor der ersten Prüfung in diesem Modul mit der Anmeldung zu der Prüfung eine bindende Erklärung über die Wahl des betreffenden Moduls und dessen Zuordnung zu einem Fach abgeben. Auf Antrag des/der Studierenden an den Prüfungsausschuss kann die Wahl oder die Zuordnung nachträglich geändert werden. Sofern bereits ein Prüfungsverfahren in einem Modul begonnen wurde, ist die Änderung der Wahl oder der Zuordnung erst nach Beendigung des Prüfungsverfahrens zulässig; dies gilt nur für Prüfungsleistungen.

(3) Zu einer Erfolgskontrolle ist zuzulassen, wer

1. in den Masterstudiengang Maschinenbau am KIT eingeschrieben ist; die Zulassung beurlaubter Studierender ist auf Prüfungsleistungen beschränkt und

2. nachweist, dass er die im Modulhandbuch für die Zulassung zu einer Erfolgskontrolle festgelegten Voraussetzungen erfüllt und

3. nachweist, dass er in dem Masterstudiengang Maschinenbau den Prüfungsanspruch nicht verloren hat.

(4) Nach Maßgabe von § 30 Abs. 5 LHG kann die Zulassung zu einzelnen Pflichtveranstaltungen beschränkt werden. Der/die Prüfende entscheidet über die Auswahl unter den Studierenden, die sich rechtzeitig bis zu dem von dem/der Prüfenden festgesetzten Termin angemeldet haben unter Berücksichtigung des Studienfortschritts dieser Studierenden und unter Beachtung von § 13 Abs. 1 Satz 1 und 2, sofern ein Abbau des Überhangs durch andere oder zusätzliche Veranstaltungen nicht möglich ist. Für den Fall gleichen Studienfortschritts sind durch die KIT-Fakultäten weitere Kriterien festzulegen. Das Ergebnis wird den Studierenden rechtzeitig bekannt gegeben.

(5) Die Zulassung ist zu versagen, wenn die in Absatz 3 und 4 genannten Voraussetzungen nicht erfüllt sind. Die Zulassung kann versagt werden, wenn die betreffende Erfolgskontrolle bereits in einem grundständigen Bachelorstudiengang am KIT erbracht wurde, der Zulassungsvoraussetzung für diesen Masterstudiengang gewesen ist. Dies gilt nicht für Mastervorzugsleistungen. Zu diesen ist eine Zulassung nach Maßgabe von Satz 1 ausdrücklich zu genehmigen.

§ 6 Durchführung von Erfolgskontrollen

(1) Erfolgskontrollen werden studienbegleitend, in der Regel im Verlauf der Vermittlung der Lehrinhalte der einzelnen Module oder zeitnah danach, durchgeführt.

(2) Die Art der Erfolgskontrolle (§ 4 Abs. 2 Nr. 1 bis 3, Abs. 3) wird von der/dem Prüfenden der betreffenden Lehrveranstaltung in Bezug auf die Lerninhalte der Lehrveranstaltung und die Lernziele des Moduls festgelegt. Die Art der Erfolgskontrolle, ihre Häufigkeit, Reihenfolge und Gewichtung sowie gegebenenfalls die Bildung der Modulnote müssen mindestens sechs Wochen vor Vorlesungsbeginn im Modulhandbuch bekannt gemacht werden. Im Einvernehmen von Prüfendem und Studierender bzw. Studierendem können die Art der Prüfungsleistung sowie die Prüfungssprache auch nachträglich geändert werden; im ersten Fall ist jedoch § 4 Abs. 4 zu berücksichtigen. Bei der Prüfungsorganisation sind die Belange Studierender mit Behinderung oder chronischer Erkrankung gemäß § 13 Abs. 1 zu berücksichtigen. § 13 Abs. 1 Satz 3 und 4 gelten entsprechend.

(3) Bei unvertretbar hohem Prüfungsaufwand kann eine schriftlich durchzuführende Prüfungsleistung auch mündlich, oder eine mündlich durchzuführende Prüfungsleistung auch schriftlich abgenommen werden. Diese Änderung muss mindestens sechs Wochen vor der Prüfungsleistung bekannt gegeben werden.

(4) Bei Lehrveranstaltungen in englischer Sprache (§ 3 Abs. 6) können die entsprechenden Erfolgskontrollen in dieser Sprache abgenommen werden. § 6 Abs. 2 gilt entsprechend.

(5) *Schriftliche Prüfungen* (§ 4 Abs. 2 Nr. 1) sind in der Regel von einer/einem Prüfenden nach § 18 Abs. 2 oder 3 zu bewerten. Sofern eine Bewertung durch mehrere Prüfende erfolgt, ergibt sich die Note aus dem arithmetischen Mittel der Einzelbewertungen. Entspricht das arithmetische Mittel keiner der in § 7 Abs. 2 Satz 2 definierten Notenstufen, so ist auf die nächstliegende Notenstufe auf- oder abzurunden. Bei gleichem Abstand ist auf die nächstbessere Notenstufe zu runden. Das Bewertungsverfahren soll sechs Wochen nicht überschreiten. Schriftliche Prüfungen dauern mindestens 60 und höchstens 300 Minuten.

(6) *Mündliche Prüfungen* (§ 4 Abs. 2 Nr. 2) sind von mehreren Prüfenden (Kollegialprüfung) oder von einer/m Prüfenden in Gegenwart einer oder eines Beisitzenden als Gruppen- oder Einzelprüfungen abzunehmen und zu bewerten. Vor der Festsetzung der Note hört die/der Prüfende die anderen an der Kollegialprüfung mitwirkenden Prüfenden an. Mündliche Prüfungen dauern in der Regel mindestens 15 Minuten und maximal 60 Minuten pro Studierenden.

Die wesentlichen Gegenstände und Ergebnisse der *mündlichen Prüfung* sind in einem Protokoll festzuhalten. Das Ergebnis der Prüfung ist den Studierenden im Anschluss an die mündliche Prüfung bekannt zu geben.

Studierende, die sich in einem späteren Semester der gleichen Prüfung unterziehen wollen, werden entsprechend den räumlichen Verhältnissen und nach Zustimmung des Prüflings als Zuhörerinnen und Zuhörer bei mündlichen Prüfungen zugelassen. Die Zulassung erstreckt sich nicht auf die Beratung und Bekanntgabe der Prüfungsergebnisse.

(7) Für *Prüfungsleistungen anderer Art* (§ 4 Abs. 2 Nr. 3) sind angemessene Bearbeitungsfristen einzuräumen und Abgabetermine festzulegen. Dabei ist durch die Art der Aufgabenstellung und durch entsprechende Dokumentation sicherzustellen, dass die erbrachte Prüfungsleistung dem/der Studierenden zurechenbar ist. Die wesentlichen Gegenstände und Ergebnisse der Erfolgskontrolle sind in einem Protokoll festzuhalten.

Bei *mündlich* durchgeführten *Prüfungsleistungen anderer Art* muss neben der/dem Prüfenden ein/e Beisitzende/r anwesend sein, die/der zusätzlich zum/r Prüfenden das Protokoll zeichnet.

Schriftliche Arbeiten im Rahmen einer *Prüfungsleistung anderer Art* haben dabei die folgende Erklärung zu tragen: „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." Trägt die Arbeit diese Erklärung nicht, wird sie nicht angenommen. Die wesentlichen Gegenstände und Ergebnisse einer solchen Erfolgskontrolle sind in einem Protokoll festzuhalten.

§ 6 a Erfolgskontrollen im Antwort-Wahl-Verfahren

Das Modulhandbuch regelt, ob und in welchem Umfang Erfolgskontrollen im Wege des *Antwort-Wahl-Verfahrens* abgelegt werden können

§ 6 b Computergestützte Erfolgskontrollen

(1) Erfolgskontrollen können computergestützt durchgeführt werden. Dabei wird die Antwort bzw. Lösung der/des Studierenden elektronisch übermittelt und, sofern möglich, automatisiert ausgewertet. Die Prüfungsinhalte sind von einer/einem Prüfenden zu erstellen.
(2) Vor der computergestützten Erfolgskontrolle hat die/der Prüfende sicherzustellen, dass die elektronischen Daten eindeutig identifiziert und unverwechselbar und dauerhaft den Studierenden zugeordnet werden können. Der störungsfreie Verlauf einer computergestützten Erfolgskontrolle ist durch entsprechende technische Betreuung zu gewährleisten, insbesondere ist die Erfolgskontrolle in Anwesenheit einer fachlich sachkundigen Person durchzuführen. Alle Prüfungsaufgaben müssen während der gesamten Bearbeitungszeit zur Bearbeitung zur Verfügung stehen.

(3) Im Übrigen gelten für die Durchführung von computergestützten Erfolgskontrollen die §§ 6 bzw. 6 a.

§ 7 Bewertung von Studien- und Prüfungsleistungen

(1) Das Ergebnis einer Prüfungsleistung wird von den jeweiligen Prüfenden in Form einer Note festgesetzt.

(2) Folgende Noten sollen verwendet werden:

sehr gut (very good)	:	hervorragende Leistung,
gut (good)	:	eine Leistung, die erheblich über den durchschnittlichen Anforderungen liegt,
befriedigend (satisfactory)	:	eine Leistung, die durchschnittlichen Anforderungen entspricht,
ausreichend (sufficient)	:	eine Leistung, die trotz ihrer Mängel noch den Anforderungen genügt,
nicht ausreichend (failed)	:	eine Leistung, die wegen erheblicher Mängel nicht den Anforderungen genügt.

Zur differenzierten Bewertung einzelner Prüfungsleistungen sind nur folgende Noten zugelassen:

1,0; 1,3	:	sehr gut
1,7; 2,0; 2,3	:	gut
2,7; 3,0; 3,3	:	befriedigend
3,7; 4,0	:	ausreichend
5,0	:	nicht ausreichend

(3) Studienleistungen werden mit „bestanden“ oder mit „nicht bestanden“ gewertet.

(4) Bei der Bildung der gewichteten Durchschnitte der Modulnoten, der Fachnoten und der Gesamtnote wird nur die erste Dezimalstelle hinter dem Komma berücksichtigt; alle weiteren Stellen werden ohne Rundung gestrichen.

(5) Jedes Modul und jede Erfolgskontrolle darf in demselben Studiengang nur einmal gewertet werden.

(6) Eine Prüfungsleistung ist bestanden, wenn die Note mindestens „ausreichend“ (4,0) ist.

(7) Die Modulprüfung ist bestanden, wenn alle erforderlichen Erfolgskontrollen bestanden sind. Die Modulprüfung und die Bildung der Modulnote sollen im Modulhandbuch geregelt werden. Sofern das Modulhandbuch keine Regelung über die Bildung der Modulnote enthält, errechnet sich die Modulnote aus einem nach den Leistungspunkten der einzelnen Teilmodule gewichteter Notendurchschnitt. Die differenzierten Noten (Absatz 2) sind bei der Berechnung der Modulnoten als Ausgangsdaten zu verwenden.

(8) Die Ergebnisse der Erfolgskontrollen sowie die erworbenen Leistungspunkte werden durch den Studierendenservice des KIT verwaltet.

(9) Die Noten der Module eines Faches gehen in die Fachnote mit einem Gewicht proportional zu den ausgewiesenen Leistungspunkten der Module ein.

(10) Die Gesamtnote der Masterprüfung, die Fachnoten und die Modulnoten lauten:

		bis	1,5	=	sehr gut
von	1,6	bis	2,5	=	gut
von	2,6	bis	3,5	=	befriedi-gend
von	3,6	bis	4,0	=	ausreichend

§ 8 Wiederholung von Erfolgskontrollen, endgültiges Nichtbestehen

(1) Studierende können eine nicht bestandene schriftliche Prüfung (§ 4 Absatz 2 Nr. 1) einmal wiederholen. Wird eine schriftliche Wiederholungsprüfung mit „nicht ausreichend“ (5,0) bewertet, so findet eine mündliche Nachprüfung im zeitlichen Zusammenhang mit dem Termin der nicht bestandenen Prüfung statt. In diesem Falle kann die Note dieser Prüfung nicht besser als „ausreichend“ (4,0) sein.

(2) Studierende können eine nicht bestandene mündliche Prüfung (§ 4 Absatz 2 Nr. 2) einmal wiederholen.

(3) Wiederholungsprüfungen nach Absatz 1 und 2 müssen in Inhalt, Umfang und Form (mündlich oder schriftlich) der ersten entsprechen. Ausnahmen kann der zuständige Prüfungsausschuss auf Antrag zulassen.

(4) Prüfungsleistungen anderer Art (§ 4 Absatz 2 Nr. 3) können einmal wiederholt werden.

(5) Studienleistungen können mehrfach wiederholt werden.

(6) Die Wiederholung von Prüfungsleistungen hat spätestens bis zum Ende des Prüfungszeitraumes des übernächsten Semesters zu erfolgen.

(7) Die Prüfungsleistung ist endgültig nicht bestanden, wenn die mündliche Nachprüfung im Sinne des Absatzes 1 mit „nicht ausreichend“ (5,0) bewertet wurde. Die Prüfungsleistung ist ferner endgültig nicht bestanden, wenn die mündliche Prüfung im Sinne des Absatzes 2 oder die Prüfungsleistung anderer Art gemäß Absatz 4 zweimal mit „nicht bestanden“ bewertet wurde.

(8) Das Modul ist endgültig nicht bestanden, wenn eine für sein Bestehen erforderliche Prüfungsleistung endgültig nicht bestanden ist.

(9) Eine zweite Wiederholung derselben Prüfungsleistung gemäß § 4 Abs. 2 ist nur in Ausnahmefällen auf Antrag des/der Studierenden zulässig („Antrag auf Zweitwiederholung“). Der Antrag ist schriftlich beim Prüfungsausschuss in der Regel bis zwei Monate nach Bekanntgabe der Note zu stellen.

Über den ersten Antrag eines/einer Studierenden auf Zweitwiederholung entscheidet der Prüfungsausschuss, wenn er den Antrag genehmigt. Wenn der Prüfungsausschuss diesen Antrag ablehnt, entscheidet ein Mitglied des Präsidiums. Über weitere Anträge auf Zweitwiederholung entscheidet nach Stellungnahme des Prüfungsausschusses ein Mitglied des Präsidiums. Wird der Antrag genehmigt, hat die Zweitwiederholung spätestens zum übernächsten Prüfungstermin zu erfolgen. Absatz 1 Satz 2 und 3 gelten entsprechend.

(10) Die Wiederholung einer bestandenen Prüfungsleistung ist nicht zulässig.

(11) Die Masterarbeit kann bei einer Bewertung mit „nicht ausreichend“ (5,0) einmal wiederholt werden. Eine zweite Wiederholung der Masterarbeit ist ausgeschlossen.

§ 9 Verlust des Prüfungsanspruchs

Ist eine nach dieser Studien- und Prüfungsordnung erforderliche Studien- oder Prüfungsleistung endgültig nicht bestanden oder eine Wiederholungsprüfung nach § 8 Abs. 6 nicht rechtzeitig erbracht oder die Masterprüfung bis zum Ende des Prüfungszeitraums des siebenten Fachsemesters einschließlich etwaiger Wiederholungen nicht vollständig abgelegt, so erlischt der Prüfungsanspruch im Studiengang Maschinenbau, es sei denn, dass die Fristüberschreitung nicht selbst zu vertreten ist. Die Entscheidung über eine Fristverlängerung und über Ausnahmen von der Fristregelung trifft der Prüfungsausschuss unter Beachtung der in § 32 Abs. 6 LHG genannten Tätigkeiten auf Antrag des/der Studierenden. Der Antrag ist schriftlich in der Regel bis sechs Wochen vor Ablauf der Frist zu stellen.

§ 10 Abmeldung; Versäumnis, Rücktritt

(1) Studierende können ihre Anmeldung zu *schriftlichen Prüfungen* ohne Angabe von Gründen bis zur Ausgabe der Prüfungsaufgaben widerrufen (Abmeldung). Eine Abmeldung kann online im Studierendenportal bis 24:00 Uhr des Vortages der Prüfung oder in begründeten Ausnahmefällen beim Studierendenservice innerhalb der Geschäftszeiten erfolgen. Erfolgt die Abmeldung gegenüber dem/der Prüfenden hat diese/r Sorge zu tragen, dass die Abmeldung im Campus Management System verbucht wird.

(2) Bei *mündlichen Prüfungen* muss die Abmeldung spätestens drei Werktage vor dem betreffenden Prüfungstermin gegenüber dem/der Prüfenden erklärt werden. Der Rücktritt von einer mündlichen Prüfung weniger als drei Werktage vor dem betreffenden Prüfungstermin ist nur unter den Voraussetzungen des Absatzes 5 möglich. Der Rücktritt von mündlichen Nachprüfungen im Sinne von § 9 Abs. 1 ist grundsätzlich nur unter den Voraussetzungen von Absatz 5 möglich.

(3) Die Abmeldung von *Prüfungsleistungen anderer Art* sowie von *Studienleistungen* ist im Modulhandbuch geregelt.

(4) Eine Erfolgskontrolle gilt als mit „nicht ausreichend“ (5,0) bewertet, wenn die Studierenden einen Prüfungstermin ohne triftigen Grund versäumen oder wenn sie nach Beginn der Erfolgskontrolle ohne triftigen Grund von dieser zurücktreten. Dasselbe gilt, wenn die Masterarbeit nicht innerhalb der vorgesehenen Bearbeitungszeit erbracht wird, es sei denn, der/die Studierende hat die Fristüberschreitung nicht zu vertreten.

(5) Der für den Rücktritt nach Beginn der Erfolgskontrolle oder das Versäumnis geltend gemachte Grund muss dem Prüfungsausschuss unverzüglich schriftlich angezeigt und glaubhaft gemacht werden. Bei Krankheit des/der Studierenden oder eines allein zu versorgenden Kindes oder pflegebedürftigen Angehörigen kann die Vorlage eines ärztlichen Attestes verlangt werden.

§ 11 Täuschung, Ordnungsverstoß

(1) Versuchen Studierende das Ergebnis ihrer Erfolgskontrolle durch Täuschung oder Benutzung nicht zugelassener Hilfsmittel zu beeinflussen, gilt die betreffende Erfolgskontrolle als mit „nicht ausreichend“ (5,0) bewertet.

(2) Studierende, die den ordnungsgemäßen Ablauf einer Erfolgskontrolle stören, können von der/dem Prüfenden oder der Aufsicht führenden Person von der Fortsetzung der Erfolgskontrolle ausgeschlossen werden. In diesem Fall gilt die betreffende Erfolgskontrolle als mit „nicht ausreichend“ (5,0) bewertet. In schwerwiegenden Fällen kann der Prüfungsausschuss diese Studierenden von der Erbringung weiterer Erfolgskontrollen ausschließen.

(3) Näheres regelt die Allgemeine Satzung des KIT zur Redlichkeit bei Prüfungen und Praktika in der jeweils gültigen Fassung.

§ 12 Mutterschutz, Elternzeit, Wahrnehmung von Familienpflichten

(1) Auf Antrag sind die Mutterschutzfristen, wie sie im jeweils gültigen Gesetz zum Schutz der erwerbstätigen Mutter (Mutterschutzgesetz - MuSchG) festgelegt sind, entsprechend zu berücksichtigen. Dem Antrag sind die erforderlichen Nachweise beizufügen. Die Mutterschutzfristen unterbrechen jede Frist nach dieser Prüfungsordnung. Die Dauer des Mutterschutzes wird nicht in die Frist eingerechnet.

(2) Gleichfalls sind die Fristen der Elternzeit nach Maßgabe des jeweils gültigen Gesetzes (Bundeselterngeld- und Elternzeitgesetz - BEEG) auf Antrag zu berücksichtigen. Der/die Studierende muss bis spätestens vier Wochen vor dem Zeitpunkt, von dem an die Elternzeit angetreten werden soll, dem Prüfungsausschuss, unter Beifügung der erforderlichen Nachweise schriftlich mitteilen, in welchem Zeitraum die Elternzeit in Anspruch genommen werden soll. Der Prüfungsausschuss hat zu prüfen, ob die gesetzlichen Voraussetzungen vorliegen, die bei einer Arbeitnehmerin bzw. einem Arbeitnehmer den Anspruch auf Elternzeit auslösen würden, und teilt dem/der Studierenden das Ergebnis sowie die neu festgesetzten Prüfungszeiten unverzüglich mit. Die Bearbeitungszeit der Masterarbeit kann nicht durch Elternzeit unterbrochen werden. Die gestellte Arbeit gilt als nicht vergeben. Nach Ablauf der Elternzeit erhält der/die Studierende ein neues Thema, das innerhalb der in § 14 festgelegten Bearbeitungszeit zu bearbeiten ist.

(3) Der Prüfungsausschuss entscheidet auf Antrag über die flexible Handhabung von Prüfungsfristen entsprechend den Bestimmungen des Landeshochschulgesetzes, wenn Studierende Familienpflichten wahrzunehmen haben. Absatz 2 Satz 4 bis 6 gelten entsprechend.

§ 13 Studierende mit Behinderung oder chronischer Erkrankung

(1) Bei der Gestaltung und Organisation des Studiums sowie der Prüfungen sind die Belange von Studierenden mit Behinderung oder chronischer Erkrankung zu berücksichtigen. Insbesondere ist Studierenden mit Behinderung oder chronischer Erkrankung bevorzugter Zugang zu teilnahmebegrenzten Lehrveranstaltungen zu gewähren und die Reihenfolge für das Absolvieren bestimmter Lehrveranstaltungen entsprechend ihrer Bedürfnisse anzupassen. Studierende sind gemäß Bundesgleichstellungsgesetz (BGG) und Sozialgesetzbuch Neuntes Buch (SGB IX) behindert, wenn ihre körperliche Funktion, geistige Fähigkeit oder seelische Gesundheit mit hoher Wahrscheinlichkeit länger als sechs Monate von dem für das Lebensalter typischen Zustand abweichen und daher ihre Teilhabe am Leben in der Gesellschaft beeinträchtigt ist. Der Prüfungsausschuss entscheidet auf Antrag der/des Studierenden über das Vorliegen der Voraussetzungen nach Satz 2 und 3. Die/der Studierende hat die entsprechenden Nachweise vorzulegen.

(2) Weisen Studierende eine Behinderung oder chronische Erkrankung nach und folgt daraus, dass sie nicht in der Lage sind, Erfolgskontrollen ganz oder teilweise in der vorgeschriebenen Zeit oder Form abzulegen, kann der Prüfungsausschuss gestatten, die Erfolgskontrollen in einem anderen Zeitraum oder einer anderen Form zu erbringen. Insbesondere ist behinderten Studierenden zu gestatten, notwendige Hilfsmittel zu benutzen.

(3) Weisen Studierende eine Behinderung oder chronische Erkrankung nach und folgt daraus, dass sie nicht in der Lage sind, die Lehrveranstaltungen regelmäßig zu besuchen oder die gemäß § 19 erforderlichen Studien- und Prüfungsleistungen zu erbringen, kann der Prüfungsausschuss auf Antrag gestatten, dass einzelne Studien- und Prüfungsleistungen nach Ablauf der in dieser Studien- und Prüfungsordnung vorgesehenen Fristen absolviert werden können.

§ 14 Modul Masterarbeit

(1) Voraussetzung für die Zulassung zum Modul Masterarbeit ist, dass die/der Studierende Modulprüfungen im Umfang von 74 LP erfolgreich abgelegt hat. Über Ausnahmen entscheidet der Prüfungsausschuss auf Antrag der/des Studierenden.

(1 a) Dem Modul Masterarbeit sind 30 LP zugeordnet. Es besteht aus der Masterarbeit und einer Präsentation. Die Präsentation hat spätestens sechs Wochen nach Abgabe der Masterarbeit zu erfolgen.

(2) Die Masterarbeit kann von Hochschullehrer/innen und leitenden Wissenschaftler/innen gemäß § 14 Abs. 3 Ziff. 1 KITG vergeben werden. Darüber hinaus kann der Prüfungsausschuss weitere Prüfende gemäß § 17 Abs. 2 und 3 zur Vergabe des Themas berechtigen. Den Studierenden ist Gelegenheit zu geben, für das Thema Vorschläge zu machen. Soll die Masterarbeit außerhalb der KIT-Fakultät für Maschinenbau angefertigt werden, so bedarf dies der Genehmigung durch den Prüfungsausschuss. Die Masterarbeit kann auch in Form einer Gruppenarbeit zugelassen werden, wenn der als Prüfungsleistung zu bewertende Beitrag der einzelnen Studierenden aufgrund objektiver Kriterien, die eine eindeutige Abgrenzung ermöglichen, deutlich unterscheidbar ist und die Anforderung nach Absatz 4 erfüllt. In Ausnahmefällen sorgt die/der Vorsitzende des Prüfungsausschusses auf Antrag der oder des Studierenden dafür, dass die/der Studierende innerhalb von vier Wochen ein Thema für die Masterarbeit erhält. Die Ausgabe des Themas erfolgt in diesem Fall über die/den Vorsitzende/n des Prüfungsausschusses.

(3) Thema, Aufgabenstellung und Umfang der Masterarbeit sind von dem Betreuer bzw. der Betreuerin so zu begrenzen, dass sie mit dem in Absatz 4 festgelegten Arbeitsaufwand bearbeitet werden kann.

(4) Die Masterarbeit soll zeigen, dass die Studierenden in der Lage sind, ein Problem aus ihrem Studienfach selbstständig und in begrenzter Zeit nach wissenschaftlichen Methoden zu bearbeiten. Der Umfang der Masterarbeit entspricht 30 Leistungspunkten. Die maximale Bearbeitungsdauer beträgt sechs Monate. Thema und Aufgabenstellung sind an den vorgesehenen Umfang anzupassen. Der Prüfungsausschuss legt fest, in welchen Sprachen die Masterarbeit geschrieben werden kann. Auf Antrag des Studierenden kann der/die Prüfende genehmigen, dass die Masterarbeit in einer anderen Sprache als Deutsch geschrieben wird.

(5) Bei der Abgabe der Masterarbeit haben die Studierenden schriftlich zu versichern, dass sie die Arbeit selbstständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt haben, die wörtlich oder inhaltlich übernommenen Stellen als solche kenntlich gemacht und die Satzung des KIT zur Sicherung guter wissenschaftlicher Praxis in der jeweils gültigen Fassung beachtet haben. Wenn diese Erklärung nicht enthalten ist, wird die Arbeit nicht angenommen. Die Erklärung kann wie folgt lauten: „Ich versichere wahrheitsgemäß, die Arbeit selbstständig 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.“ Bei Abgabe einer unwahren Versicherung wird die Masterarbeit mit „nicht ausreichend“ (5,0) bewertet.

(6) Der Zeitpunkt der Ausgabe des Themas der Masterarbeit ist durch die Betreuerin/den Betreuer und die/den Studierenden festzuhalten und dies beim Prüfungsausschuss aktenkundig zu machen. Der Zeitpunkt der Abgabe der Masterarbeit ist durch den/die Prüfende/n beim Prüfungsausschuss aktenkundig zu machen. Das Thema kann nur einmal und nur innerhalb des ersten Monats der Bearbeitungszeit zurückgegeben werden. Macht der oder die Studierende einen triftigen Grund geltend, kann der Prüfungsausschuss die in Absatz 4 festgelegte Bearbeitungszeit auf Antrag der oder des Studierenden um höchstens drei Monate verlängern. Wird die Masterarbeit nicht fristgerecht abgeliefert, gilt sie als mit „nicht ausreichend“ (5,0) bewertet, es sei denn, dass die Studierenden dieses Versäumnis nicht zu vertreten haben.

(7) Die Masterarbeit wird von mindestens einem/einer Hochschullehrer/in oder einem/einer leitenden Wissenschaftler/in gemäß § 14 abs. 3 Ziff. 1 KITG und einem/einer weiteren Prüfenden bewertet. In der Regel ist eine/r der Prüfenden die Person, die die Arbeit gemäß Absatz 2 vergeben hat. Bei nicht übereinstimmender Beurteilung dieser beiden Personen setzt der Prüfungsausschuss im Rahmen der Bewertung dieser beiden Personen die Note der Masterarbeit fest; er kann auch einen weiteren Gutachter bestellen. Die Bewertung hat innerhalb von sechs Wochen nach Abgabe der Masterarbeit zu erfolgen.

§ 15 Zusatzleistungen

(1) Es können auch weitere Leistungspunkte (Zusatzleistungen) im Umfang von höchstens 30 LP aus dem Gesamtangebot des KIT erworben werden. § 3 und § 4 der Prüfungsordnung bleiben davon unberührt. Diese Zusatzleistungen gehen nicht in die Festsetzung der Gesamt- und Modulnoten ein. Die bei der Festlegung der Modulnote nicht berücksichtigten LP werden als Zusatzleistungen im Transcript of Records aufgeführt und als Zusatzleistungen gekennzeichnet. Auf Antrag der/des Studierenden werden die Zusatzleistungen in das Masterzeugnis aufgenommen und als Zusatzleistungen gekennzeichnet. Zusatzleistungen werden mit den nach § 7 vorgesehenen Noten gelistet.

(2) Die Studierenden haben bereits bei der Anmeldung zu einer Prüfung in einem Modul diese als Zusatzleistung zu deklarieren.

§ 16 Prüfungsausschuss

(1) Für den Masterstudiengang Maschinenbau wird ein Prüfungsausschuss gebildet. Er besteht aus vier stimmberechtigten Mitgliedern: zwei Hochschullehrer/innen / leitenden Wissenschaftler/innen gemäß § 14 Abs. 3 Ziff. 1 KITG / Privatdozentinnen bzw. -dozenten, zwei akademischen Mitarbeiterinnen und Mitarbeitern nach § 52 LHG / wissenschaftlichen Mitarbeiter/innen gemäß § 14 Abs. 3 Ziff. 2 KITG und einer bzw. einem Studierenden mit beratender Stimme. Im Falle der Einrichtung eines gemeinsamen Prüfungsausschusses für den Bachelor- und den Masterstudiengang Maschinenbau erhöht sich die Anzahl der Studierenden auf zwei Mitglieder mit beratender Stimme, wobei je eine bzw. einer dieser beiden aus dem Bachelor- und aus dem Masterstudiengang stammt. Die Amtszeit der nichtstudentischen Mitglieder beträgt zwei Jahre, die des studentischen Mitglieds ein Jahr.

(2) Die/der Vorsitzende, ihre/sein Stellvertreter/in, die weiteren Mitglieder des Prüfungsausschusses sowie deren Stellvertreter/innen werden von dem KIT-Fakultätsrat bestellt, die akademischen Mitarbeiter/innen nach § 52 LHG, die wissenschaftlichen Mitarbeiter gemäß § 14 Abs. 3 Ziff. 2 KITG und die Studierenden auf Vorschlag der Mitglieder der jeweiligen Gruppe; Wiederbestellung ist möglich. Die/der Vorsitzende und deren/dessen Stellvertreter/in müssen Hochschullehrer/innen oder leitende Wissenschaftler/innen § 14 Abs. 3 Ziff. 1 KITG sein. Die/der Vorsitzende des Prüfungsausschusses nimmt die laufenden Geschäfte wahr und wird durch das jeweilige Prüfungssekretariat unterstützt.

(3) Der Prüfungsausschuss achtet auf die Einhaltung der Bestimmungen dieser Studien- und Prüfungsordnung und fällt die Entscheidungen in Prüfungsangelegenheiten. Er entscheidet über die Anerkennung von Studienzeiten sowie Studien- und Prüfungsleistungen und trifft die Feststellung gemäß § 18 Absatz 1 Satz 1. Er berichtet der KIT-Fakultät regelmäßig über die Entwicklung der Prüfungs- und Studienzeiten, einschließlich der Bearbeitungszeiten für die Masterarbeiten und die Verteilung der Modul- und Gesamtnoten. Er ist zuständig für Anregungen zur Reform der Studien- und Prüfungsordnung und zu Modulbeschreibungen. Der Prüfungsausschuss entscheidet mit der Mehrheit seiner Stimmen. Bei Stimmengleichheit entscheidet der Vorsitzende des Prüfungsausschusses.

(4) Der Prüfungsausschuss kann die Erledigung seiner Aufgaben für alle Regelfälle auf die/den Vorsitzende/n des Prüfungsausschusses übertragen. In dringenden Angelegenheiten, deren Erledigung nicht bis zu der nächsten Sitzung des Prüfungsausschusses warten kann, entscheidet die/der Vorsitzende des Prüfungsausschusses.

(5) Die Mitglieder des Prüfungsausschusses haben das Recht, der Abnahme von Prüfungen beizuwohnen. Die Mitglieder des Prüfungsausschusses, die Prüfenden und die Beisitzenden unterliegen der Verschwiegenheit. Sofern sie nicht im öffentlichen Dienst stehen, sind sie durch die/den Vorsitzende/n zur Verschwiegenheit zu verpflichten.

(6) In Angelegenheiten des Prüfungsausschusses, die eine an einer anderen KIT-Fakultät zu absolvierende Prüfungsleistung betreffen, ist auf Antrag eines Mitgliedes des Prüfungsausschusses eine fachlich zuständige und von der betroffenen KIT-Fakultät zu nennende prüfungsberechtigte Person hinzuzuziehen.

(7) Belastende Entscheidungen des Prüfungsausschusses sind schriftlich mitzuteilen. Sie sind zu begründen und mit einer Rechtsbehelfsbelehrung zu versehen. Vor einer Entscheidung ist Gelegenheit zur Äußerung zu geben. Widersprüche gegen Entscheidungen des Prüfungsausschusses sind innerhalb eines Monats nach Zugang der Entscheidung schriftlich oder zur Niederschrift beim Präsidium des KIT einzulegen.

§ 17 Prüfende und Beisitzende

(1) Der Prüfungsausschuss bestellt die Prüfenden. Er kann die Bestellung der/dem Vorsitzenden übertragen.

(2) Prüfende sind Hochschullehrer/innen sowie leitende Wissenschaftler/innen gemäß § 14 Abs. 3 Ziff. 1 KITG, habilitierte Mitglieder und akademische Mitarbeiter/innen gemäß § 52 LHG, welche der KIT-Fakultät angehören und denen die Prüfungsbefugnis übertragen wurde; desgleichen kann wissenschaftlichen Mitarbeitern gemäß § 14 Abs. 3 Ziff. 2 KITG die Prüfungsbefugnis übertragen werden. Bestellt werden darf nur, wer mindestens die dem jeweiligen Prüfungsgegenstand entsprechende fachwissenschaftliche Qualifikation erworben hat.

(3) Soweit Lehrveranstaltungen von anderen als den unter Absatz 2 genannten Personen durchgeführt werden, sollen diese zu Prüfenden bestellt werden, sofern die KIT-Fakultät eine Prüfungsbefugnis erteilt hat und sie die gemäß Absatz 2 Satz 2 vorausgesetzte Qualifikation nachweisen können.

(4) Die Beisitzenden werden durch die Prüfenden benannt. Zu Beisitzenden darf nur bestellt werden, wer einen akademischen Abschluss in einem mathematisch-naturwissenschaftlichen oder ingenieurwissenschaftlichen Studiengang oder einen gleichwertigen akademischen Abschluss erworben hat.

§ 18 Anerkennung von Studien- und Prüfungsleistungen, Studienzeiten

(1) Studien- und Prüfungsleistungen sowie Studienzeiten, die in Studiengängen an staatlichen oder staatlich anerkannten Hochschulen und Berufsakademien der Bundesrepublik Deutschland oder an ausländischen staatlichen oder staatlich anerkannten Hochschulen erbracht wurden, werden auf Antrag der Studierenden anerkannt, sofern hinsichtlich der erworbenen Kompetenzen kein wesentlicher Unterschied zu den Leistungen oder Abschlüssen besteht, die ersetzt werden sollen. Dabei ist kein schematischer Vergleich, sondern eine Gesamtbetrachtung vorzunehmen. Bezüglich des Umfangs einer zur Anerkennung vorgelegten Studienleistung bzw. Prüfungsleistung (Anrechnung) werden die Grundsätze des ECTS herangezogen.

(2) Die Studierenden haben die für die Anerkennung erforderlichen Unterlagen vorzulegen. Studierende, die neu in den Masterstudiengang Maschinenbau immatrikuliert wurden, haben den Antrag mit den für die Anerkennung erforderlichen Unterlagen innerhalb eines Semesters nach Immatrikulation zu stellen. Bei Unterlagen, die nicht in deutscher oder englischer Sprache vorliegen, kann eine amtlich beglaubigte Übersetzung verlangt werden. Die Beweislast dafür, dass der Antrag die Voraussetzungen für die Anerkennung nicht erfüllt, liegt beim Prüfungsausschuss.

(3) Werden Leistungen angerechnet, die nicht am KIT erbracht wurden, werden sie im Zeugnis als „anerkannt“ ausgewiesen. Liegen Noten vor, werden die Noten, soweit die Notensysteme vergleichbar sind, übernommen und in die Berechnung der Modulnoten und der Gesamtnote einbezogen. Sind die Notensysteme nicht vergleichbar, können die Noten umgerechnet werden. Liegen keine Noten vor, wird der Vermerk „bestanden“ aufgenommen.

(4) Bei der Anerkennung von Studien- und Prüfungsleistungen, die außerhalb der Bundesrepublik Deutschland erbracht wurden, sind die von der Kultusministerkonferenz und der Hochschulrektorenkonferenz gebilligten Äquivalenzvereinbarungen sowie Absprachen im Rahmen der Hochschulpartnerschaften zu beachten.

(5) Außerhalb des Hochschulsystems erworbene Kenntnisse und Fähigkeiten werden angerechnet, wenn sie nach Inhalt und Niveau den Studien- und Prüfungsleistungen gleichwertig sind, die ersetzt werden sollen und die Institution, in der die Kenntnisse und Fähigkeiten erworben wurden, ein genormtes Qualitätssicherungssystem hat. Die Anrechnung kann in Teilen versagt werden, wenn mehr als 50 Prozent des Hochschulstudiums ersetzt werden soll.

(6) Zuständig für Anerkennung und Anrechnung ist der Prüfungsausschuss. Im Rahmen der Feststellung, ob ein wesentlicher Unterschied im Sinne des Absatz 1 vorliegt, sind die zuständigen Fachvertreter/innen zu hören. Der Prüfungsausschuss entscheidet in Abhängigkeit von Art und Umfang der anzurechnenden Studien- und Prüfungsleistungen über die Einstufung in ein höheres Fachsemester.

II. Masterprüfung

§ 19 Umfang und Art der Masterprüfung

(1) Die Masterprüfung besteht aus den Modulprüfungen nach Absatz 2 und 3 sowie der Modul Masterarbeit (§ 14).

(2) Es sind Modulprüfungen im Pflichtfach „Vertiefung ingenieurwissenschaftlicher Grundlagen“ im Umfang von 50 LP abzulegen.

Die Festlegung der zur Auswahl stehenden Module wird im Modulhandbuch getroffen.

(3) Im Wahlpflichtbereich ist ein Wahlpflichtfach im Umfang von 40 LP zu absolvieren. Zur Auswahl steht mindestens das Fach „Allgemeiner Maschinenbau“. Die Festlegung der weiteren zur Auswahl stehenden Fächer und der den Fächern zugeordneten Module wird im Modulhandbuch getroffen.

§ 20 Bestehen der Masterprüfung, Bildung der Gesamtnote

(1) Die Masterprüfung ist bestanden, wenn alle in § 19 genannten Modulprüfungen mindestens mit „ausreichend“ bewertet wurden.

(2) Die Gesamtnote der Masterprüfung errechnet sich als ein mit Leistungspunkten gewichteter Notendurchschnitt der Fachnoten und dem Modul Masterarbeit.

(3) Haben Studierende die Masterarbeit mit der Note 1,0 und die Masterprüfung mit einem Durchschnitt von 1,2 oder besser abgeschlossen, so wird das Prädikat „mit Auszeichnung“ (with distinction) verliehen.

§ 21 Masterzeugnis, Masterurkunde, Diploma Supplement und Transcript of Records

(1) Über die Masterprüfung werden nach Bewertung der letzten Prüfungsleistung eine Masterurkunde und ein Zeugnis erstellt. Die Ausfertigung von Masterurkunde und Zeugnis soll nicht später als drei Monate nach Ablegen der letzten Prüfungsleistung erfolgen. Masterurkunde und Masterzeugnis werden in deutscher und englischer Sprache ausgestellt. Masterurkunde und Zeugnis tragen das Datum der erfolgreichen Erbringung der letzten Prüfungsleistung. Diese Dokumente werden den Studierenden zusammen ausgehändigt. In der Masterurkunde wird die Verleihung des akademischen Mastergrades beurkundet. Die Masterurkunde wird von dem Präsidenten und der KIT-Dekanin/ dem KIT-Dekan der KIT-Fakultät unterzeichnet und mit dem Siegel des KIT versehen.

(2) Das Zeugnis enthält die Fach- und Modulnoten sowie die den Modulen und Fächern zugeordnete Leistungspunkte und die Gesamtnote. Sofern gemäß § 7 Abs. 2 Satz 2 eine differenzierte Bewertung einzelner Prüfungsleitungen vorgenommen wurde, wird auf dem Zeugnis auch die entsprechende Dezimalnote ausgewiesen; § 7 Abs. 4 bleibt unberührt. Das Zeugnis ist von der KIT-Dekanin/ dem KIT-Dekan der KIT-Fakultät und von der/dem Vorsitzenden des Prüfungsausschusses zu unterzeichnen.

(3) Mit dem Zeugnis erhalten die Studierenden ein Diploma Supplement in deutscher und englischer Sprache, das den Vorgaben des jeweils gültigen ECTS Users‘ Guide entspricht, sowie ein Transcript of Records in deutscher und englischer Sprache.

(4) Das Transcript of Records enthält in strukturierter Form alle erbrachten Studien- und Prüfungsleistungen. Dies beinhaltet alle Fächer und Fachnoten samt den zugeordneten Leistungspunkten, die dem jeweiligen Fach zugeordneten Module mit den Modulnoten und zugeordneten Leistungspunkten sowie die den Modulen zugeordneten Erfolgskontrollen samt Noten und zugeordneten Leistungspunkten. Absatz 2 Satz 2 gilt entsprechend. Aus dem Transcript of Records soll die Zugehörigkeit von Lehrveranstaltungen zu den einzelnen Modulen deutlich erkennbar sein. Angerechnete Studien- und Prüfungsleistungen sind im Transcript of Records aufzunehmen. Alle Zusatzleistungen werden im Transcript of Records aufgeführt.

(5) Die Masterurkunde, das Masterzeugnis und das Diploma Supplement, einschließlich des Transcript of Records, werden vom Studierendenservice des KIT ausgestellt.

III. Schlussbestimmungen

§ 22 Bescheinigung von Prüfungsleistungen

Haben Studierende die Masterprüfung endgültig nicht bestanden, wird ihnen auf Antrag und gegen Vorlage der Exmatrikulationsbescheinigung eine schriftliche Bescheinigung ausgestellt, die die erbrachten Studien- und Prüfungsleistungen und deren Noten enthält und erkennen lässt, dass die Prüfung insgesamt nicht bestanden ist. Dasselbe gilt, wenn der Prüfungsanspruch erloschen ist.

§ 23 Aberkennung des Mastergrades

(1) Haben Studierende bei einer Prüfungsleistung getäuscht und wird diese Tatsache nach der Aushändigung des Zeugnisses bekannt, so können die Noten der Modulprüfungen, bei denen getäuscht wurde, berichtigt werden. Gegebenenfalls kann die Modulprüfung für „nicht ausreichend“ (5,0) und die Masterprüfung für „nicht bestanden“ erklärt werden.

(2) Waren die Voraussetzungen für die Zulassung zu einer Prüfung nicht erfüllt, ohne dass die/der Studierende darüber täuschen wollte, und wird diese Tatsache erst nach Aushändigung des Zeugnisses bekannt, wird dieser Mangel durch das Bestehen der Prüfung geheilt. Hat die/der Studierende die Zulassung vorsätzlich zu Unrecht erwirkt, so kann die Modulprüfung für „nicht ausreichend“ (5,0) und die Masterprüfung für „nicht bestanden“ erklärt werden.

(3) Vor einer Entscheidung des Prüfungsausschusses ist Gelegenheit zur Äußerung zu geben.

(4) Das unrichtige Zeugnis ist zu entziehen und gegebenenfalls ein neues zu erteilen. Mit dem unrichtigen Zeugnis ist auch die Masterurkunde einzuziehen, wenn die Masterprüfung aufgrund einer Täuschung für „nicht bestanden“ erklärt wurde.

(5) Eine Entscheidung nach Absatz 1 und Absatz 2 Satz 2 ist nach einer Frist von fünf Jahren ab dem Datum des Zeugnisses ausgeschlossen.

(6) Die Aberkennung des akademischen Grades richtet sich nach § 36 Abs. 7 LHG.

§ 24 Einsicht in die Prüfungsakten

(1) Nach Abschluss der Masterprüfung wird den Studierenden auf Antrag innerhalb eines Jahres Einsicht in das Prüfungsexemplar ihrer Masterarbeit, die darauf bezogenen Gutachten und in die Prüfungsprotokolle gewährt.

(2) Für die Einsichtnahme in die schriftlichen Modulprüfungen, schriftlichen Modulteilprüfungen bzw. Prüfungsprotokolle gilt eine Frist von einem Monat nach Bekanntgabe des Prüfungsergebnisses.

(3) Der/die Prüfende bestimmt Ort und Zeit der Einsichtnahme.

(4) Prüfungsunterlagen sind mindestens fünf Jahre aufzubewahren.

§ 25 Inkrafttreten, Übergangsvorschriften

(1) Diese Studien- und Prüfungsordnung tritt am 01. Oktober 2016 in Kraft.

(2) Gleichzeitig tritt die Studien- und Prüfungsordnung des KIT für den Masterstudiengang Maschinenbau vom 28. Februar 2008 (Amtliche Bekanntmachung des KIT Nr. 79 vom 09. September 2008), zuletzt geändert durch Satzung vom 24. September 2014 (Amtliche Bekanntmachung des KIT Nr. 54 vom 01. Oktober 2014), außer Kraft.

(3) Studierende, die auf Grundlage der Studien- und Prüfungsordnung für den Masterstudiengang Maschinenbau vom 28. Februar 2008 (Amtliche Bekanntmachung des KIT Nr. 79 vom 09. September 2008), zuletzt geändert durch Satzung vom 24. September 2014 (Amtliche Bekanntmachung des KIT Nr. 54 vom 01. Oktober 2014), ihr Studium am KIT aufgenommen haben, können Prüfungen auf Grundlage dieser Studien- und Prüfungsordnung letztmalig am 30. September 2020 ablegen.

(4) Studierende, die auf Grundlage der Studien- und Prüfungsordnung für den Masterstudiengang Maschinenbau vom 28. Februar 2008 (Amtliche Bekanntmachung des KIT Nr. 79 vom 09. September 2008), zuletzt geändert durch Satzung vom 24. September 2014 (Amtliche Bekanntmachung des KIT Nr. 54 vom 01. Oktober 2014), ihr Studium am KIT aufgenommen haben, können auf Antrag ihr Studium nach der vorliegenden Studien- und Prüfungsordnung fortsetzen.

(5) Die Prüfungsordnung für den Diplomstudiengang Maschinenbau vom 27. Juli 2000 (Amtliche Bekanntmachung der Universität Karlsruhe (TH) Nr. 18 vom 15. August 2000, S. 107 ff.) bleibt außer Kraft. Studierende, die auf Grundlage der Prüfungsordnung für den Diplomstudiengang Maschinenbau vom 27. Juli 2000 (Amtliche Bekanntmachung der Universität Karlsruhe (TH) Nr. 18 vom 15. August 2000, S. 107 ff.) ihr Studium an der Universität Karlsruhe (TH) aufgenommen haben, können die Diplomprüfung einschließlich etwaiger Wiederholungen letztmalig bis zum 30. September 2017 ablegen.

Karlsruhe, den 04. August 2015

Professor Dr.-Ing. Holger Hanselka
(Präsident)

Karlsruher Institut für Technologie

Die Forschungsuniversität in der Helmholtz-Gemeinschaft

Amtliche Bekanntmachung

2019 **Ausgegeben Karlsruhe, den 26. Februar 2019** **Nr. 04**

I n h a l t **Seite**

Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Maschinenbau

vom 21. Februar 2019

Aufgrund von § 10 Absatz 2 Ziff. 5 und § 20 Absatz 2 Satz 1 des Gesetzes über das Karlsruher Institut für Technologie (KIT-Gesetz - KITG) in der Fassung vom 14. Juli 2009 (GBl. S. 317 f), zuletzt geändert durch Artikel 2 des Gesetzes zur Weiterentwicklung des Hochschulrechts (HRWeitEG) vom 13. März 2018 (GBl S. 85, 94), und § 32 Absatz 3 Satz 1 des Gesetzes über die Hochschulen in Baden-Württemberg (Landeshochschulgesetz - LHG) in der Fassung vom 1. Januar 2005 (GBl. S. 1 f), zuletzt geändert durch Artikel 1 des Gesetzes zur Weiterentwicklung des Hochschulrechts (HRWeitEG) vom 13. März 2018 (GBl. S. 85) hat der KIT-Senat am 18. Februar 2019 die folgende Satzung zur Änderung der Studien- und Prüfungsordnung für den Masterstudiengang Maschinenbau vom 04. August 2015 (Amtliche Bekanntmachung des Karlsruher Instituts für Technologie (KIT) Nr. 61 vom 06. August 2015) beschlossen.

Der Präsident hat seine Zustimmung gemäß § 20 Absatz 2 Satz 1 KITG i.V.m. § 32 Absatz 3 Satz 1 LHG am 21. Februar 2019 erteilt.

Artikel 1 – Änderung der Studien- und Prüfungsordnung

1. § 12 Absatz 1 wird wie folgt geändert:

a) Satz 1 wird wie folgt gefasst:

„Es gelten die Vorschriften des Gesetzes zum Schutz von Müttern bei der Arbeit, in der Ausbildung und im Studium (Mutterschutzgesetz – MuSchG) in seiner jeweils geltenden Fassung.“

b) Satz 2 wird aufgehoben.

c) Die bisherigen Sätze 3 und 4 werden die Sätze 2 und 3

2. § 14 wird wie folgt geändert:

a) In Absatz 2 Satz 1 werden nach den Wörtern „Hochschullehrer/innen“ das Wort “und“ durch ein Komma ersetzt und nach der Angabe „§ 14 Abs. 3 Ziff. 1 KITG“ die Wörter „und habilitierten Mitgliedern der KIT-Fakultät für Maschinenbau“ eingefügt.

b) In Absatz 7 Satz 1 werden nach den Wörtern „Hochschullehrer/innen“ das Wort “oder“ durch ein Komma ersetzt und nach der Angabe „§ 14 abs. 3 Ziff. 1 KITG“ die Wörter „oder einem habilitierten Mitglied der KIT-Fakultät für Maschinenbau“ eingefügt.

3. § 16 wird wie folgt geändert:

a) In Absatz 1 Satz 3 wird das Wort „stammt“ durch die Wörter „stammen soll“ ersetzt.

b) In Absatz 7 Satz 4 werden nach dem Wort „Entscheidung“ die Wörter „schriftlich oder zur Niederschrift“ gestrichen.

4. § 17 Absatz 3 wird wie folgt geändert:

Nach dem Wort „sofern" werden die Wörter „die KIT-Fakultät eine Prüfungsbefugnis erteilt hat und" gestrichen.

Artikel 2 – Inkrafttreten

Diese Änderungssatzung tritt zum 01. April 2019 in Kraft.

Karlsruhe, den 21. Februar 2019

gez. Prof. Dr.-Ing. Holger Hanselka
(Präsident)

Karlsruher Institut für Technologie

Die Forschungsuniversität in der Helmholtz-Gemeinschaft

Amtliche Bekanntmachung

2017 Ausgegeben Karlsruhe, den 24. November 2017 Nr. 68

I n h a l t **Seite**

Satzung für den Zugang zu dem Masterstudiengang Maschinenbau am Karlsruher Institut für Technologie (KIT)

vom 22. November 2017

Aufgrund von § 10 Abs. 2 Ziff. 6 und § 20 des KIT-Gesetzes (KITG), zuletzt geändert durch Artikel 4 des Gesetzes zur Änderung des Landeshochschulgebührengesetzes und anderer Gesetze vom 09. Mai 2017 (GBl. S. 245, 250), §§ 59 Abs. 1, 63 Abs. 2 des Landeshochschulgesetzes (LHG) in der Fassung vom 1. Januar 2005 (GBl. S. 1 f), zuletzt geändert durch Artikel 3 des Gesetzes zur Änderung des Landeshochschulgebührengesetzes und anderer Gesetze vom 09. Mai 2017 (GBl. S. 245, 250), hat der KIT-Senat in seiner Sitzung am 20. November 2017 die nachstehende Satzung beschlossen.

§ 1 Anwendungsbereich

Die Satzung regelt den Zugang zu dem Masterstudiengang Maschinenbau am Karlsruher Institut für Technologie (im Folgenden: KIT).

§ 2 Fristen

(1) Eine Immatrikulation erfolgt sowohl zum Winter- als auch zum Sommersemester.

(2) Der Antrag auf Immatrikulation einschließlich aller erforderlichen Unterlagen muss

- für das **Wintersemester** bis zum **30. September eines Jahres**
- für das **Sommersemester** bis zum **31. März eines Jahres**

beim KIT eingegangen sein.

§ 3 Form des Antrages

(1) Die Form des Antrags richtet sich nach den allgemeinen für das Zulassungs- und Immatrikulationsverfahren geltenden Bestimmungen in der jeweils gültigen Zulassungs- und Immatrikulationsordnung des KIT.

(2) Dem Antrag sind folgende Unterlagen beizufügen:

1. eine Kopie des Nachweises über den Bachelorabschluss oder gleichwertigen Abschluss gemäß § 5 Abs. 1 Nr. 1 samt Diploma Supplement und Transcript of Records (unter Angabe der erbrachten Leistungspunkte/ECTS),
2. Nachweise der in § 5 Abs. 1 Nr. 3 genannten Mindestkenntnisse und Mindestleistungen, aus denen die Lernziele, Studieninhalte und Leistungspunkte hervorgehen, ggfs. Nachweis einer erfolgreichen Aufnahmeprüfung gemäß § 7 Abs. 2,
3. ein Nachweis über ein mindestens 18-wöchiges Berufspraktikum, welches durch das Praktikantenamt der KIT-Fakultät für Maschinenbau anerkannt wurde (§ 6),
4. eine schriftliche Erklärung der/des Bewerber/in darüber, ob sie/er in dem Masterstudiengang Maschinenbau oder einem verwandten Studiengang mit im Wesentlichen gleichem

Inhalt gemäß § 5 Abs. 2 eine nach der Prüfungsordnung erforderliche Prüfung endgültig nicht bestanden hat oder der Prüfungsanspruch aus sonstigen Gründen nicht mehr besteht,

5. Nachweise über die in § 5 Abs. 1 Nr. 5 a) oder b) genannten Sprachkenntnisse,

6. die in der jeweils gültigen Zulassungs- und Immatrikulationsordnung genannten weiteren Unterlagen.

Das KIT kann verlangen, dass diese der Zugangsentscheidung zugrundeliegenden Dokumente bei der Einschreibung im Original vorzulegen sind.

(3) Die Immatrikulation in den Masterstudiengang Maschinenbau kann auch beantragt werden, wenn bis zum Ablauf der Bewerbungsfrist im Sinne des § 2 der Bachelorabschluss noch nicht vorliegt und aufgrund des bisherigen Studienverlaufs, insbesondere der bisherigen Studien- und Prüfungsleistungen zu erwarten ist, dass die/der Bewerber/in das Bachelorstudium rechtzeitig vor Beginn des Masterstudiengangs Maschinenbau abschließt.

In diesem Fall sind die bis zu diesem Zeitpunkt erbrachten Studien- und Prüfungsleistungen im Rahmen der Zugangsentscheidung zu berücksichtigen. Das spätere Ergebnis des Bachelorabschlusses bleibt unbeachtet. Der Bewerbung ist

a) eine Bescheinigung über die bis zum Ende der Bewerbungsfrist erbrachten Prüfungsleistungen (z.B. Notenauszug) sowie

b) eine Übersicht aller noch nicht nachgewiesenen Prüfungs- und Studienleistungen mit Angabe des Prüfungsdatums und des Nachweises der Prüfungsanmeldung beizulegen.

§ 4 Zugangskommission

(1) Zur Vorbereitung der Zugangsentscheidung setzt die KIT-Fakultät eine Zugangskommission ein, die aus mindestens zwei Personen des hauptberuflich tätigen wissenschaftlichen Personals, davon einer/einem Professor/in, besteht. Ein/e studentische/r Vertreter/in kann mit beratender Stimme an den Zugangskommissionssitzungen teilnehmen. Eines der Mitglieder der Zugangskommission führt den Vorsitz.

(2) Für den Fall, dass aufgrund hoher Bewerberzahlen mehrere Zugangskommissionen gebildet werden, findet zu Beginn des Zugangsverfahrens in einer gemeinsamen Sitzung eine Abstimmung der Bewertungsmaßstäbe unter dem Vorsitz der/des Studiendekans/Studiendekanin statt. Am Ende des Verfahrens kann eine gemeinsame Schlussbesprechung durchgeführt werden.

(3) Die Zugangskommission berichtet dem KIT-Fakultätsrat nach Abschluss des Zugangsverfahrens über die gesammelten Erfahrungen und macht Vorschläge zur Verbesserung und Weiterentwicklung des Zugangsverfahrens.

(4) Die Amtszeit der nicht studentischen Kommissionsmitglieder beträgt zwei Jahre, die des studentischen Kommissionsmitgliedes ein Jahr. Eine Wiederbestellung ist möglich.

§ 5 Zugangsvoraussetzungen

(1) Voraussetzungen für den Zugang zum Masterstudiengang Maschinenbau sind:

1. Ein bestandener Bachelorabschluss oder mindestens gleichwertiger Abschluss in dem Studiengang Maschinenbau oder einem Studiengang mit im Wesentlichen gleichem Inhalt an einer Universität, Fachhochschule oder Berufsakademie bzw. Dualen Hochschule oder an einer ausländischen Hochschule; das Studium muss im Rahmen einer mindestens dreijährigen Regelstudienzeit und mit einer Mindestanzahl von 180 ECTS-Punkten absolviert worden sein;

2. ein mindestens 18-wöchiges Berufspraktikum, welches durch das Praktikantenamt der KIT-Fakultät für Maschinenbau anerkannt wurde (§ 6);

3. notwendige durch den Bachelorabschluss vermittelte Mindestkenntnisse und Mindestleistungen gemäß § 7;

4. dass im Masterstudiengang Maschinenbau oder einem verwandten Studiengang mit im Wesentlichen gleichem Inhalt kein endgültiges Nichtbestehen einer nach der Prüfungsordnung erforderlichen Prüfung vorliegt und der Prüfungsanspruch auch aus sonstigen Gründen noch besteht;

5. für Bewerber/innen, deren Muttersprache nicht Deutsch oder Englisch ist, der Nachweis von

   a) ausreichenden Kenntnissen der deutschen Sprache gemäß den Voraussetzungen der Zulassungs- und Immatrikulationsordnung des KIT oder

   b) ausreichenden Kenntnissen der englischen Sprache, nachgewiesen durch ein Zertifikat über das Kompetenzniveau B2 oder höher gemäß dem Gemeinsamen europäischen Referenzrahmen für Sprachen oder ein vergleichbares Zertifikat; als vergleichbar gelten ein Test of English as Foreign Language (TOEFL) mit mindestens 570 Punkten im paper-based TOEFL Test, 250 Punkten im computer-based TOEFL Test oder 88 Punkten im internet-based TOEFL Test sowie IELTS mit mindestens 6,5 Punkten. Der Nachweis englischer Sprachkenntnisse entfällt für Bewerber/innen, die ihren Bachelorabschluss in einem englischsprachigen Studiengang oder im englischsprachigen Ausland erworben haben. Die offizielle Sprache des Studienprogramms muss auf dem Abschlusszeugnis, dessen Ergänzung, im Transcript of Records oder in einer entsprechenden Bescheinigung der Hochschule vermerkt sein.

(2) Als verwandte Studiengänge gemäß Absatz 1 Nr. 4 gelten insbesondere ein Masterstudiengang Mechatronik, Mechatronik und Informationstechnik, Werkstofftechnik, Materialwissenschaft und Werkstofftechnik, Werkstoffingenieurwesen, Fahrzeugtechnik, Kraftfahrzeugtechnik, Luft- und Raumfahrttechnik, Motorentechnik, Produktionstechnik, Fertigungstechnik, Automatisierungstechnik, Entwicklung und Konstruktion, Mechanik, Mechanical Engineering, Mechatronics, Mechatronics and Information Technology, Materials Science, Automotive Engineering, Aerospace Engineering, Production Systems Engineering, Manufacturing Technology, Conception and Production in Mechanical Engineering, Computational Mechanics, Computational Mechanics of Materials and Structures, Energy Technologies, Automation. Über die Gleichwertigkeit des Bachelorabschlusses im Sinne von Absatz 1 Nr. 1 sowie die Festlegung der Studiengänge mit im Wesentlichen gleichem Inhalt im Sinne von Absatz 1 Nr. 4 über Satz 1 hinaus entscheidet die Zugangskommission des Masterstudiengangs Maschinenbau im Benehmen mit dem Prüfungsausschuss des Masterstudiengangs Maschinenbau. Bei der Anerkennung von ausländischen Abschlüssen sind die Empfehlungen der Kultusministerkonferenz sowie die Absprachen im Rahmen von Hochschulpartnerschaften zu beachten.

§ 6 Berufspraktikum

(1) Der Zugang zum Masterstudiengang Maschinenbau setzt ein mindestens 18-wöchiges Berufspraktikum voraus. Davon sind mindestens zwölf Wochen als Fachpraktikum abzuleisten. Maximal sechs Wochen können als Grundpraktikum abgeleistet werden.

(2) Die Tätigkeiten im **Grundpraktikum** können aus folgenden Gebieten gewählt werden:

1. spanende Fertigungsverfahren,
2. umformende Fertigungsverfahren,
3. urformende Fertigungsverfahren und
4. thermische Füge- und Trennverfahren.

Es sollen Tätigkeiten in mindestens drei der o.g. Gebiete nachgewiesen werden.

(3) Die Tätigkeiten im **Fachpraktikum** müssen inhaltlich denen eines Ingenieurs entsprechen und können beispielsweise aus folgenden Gebieten gewählt werden:

1. Wärmebehandlung,
2. Werkzeug- und Vorrichtungsbau,
3. Planung von Instandhaltung, Wartung und Reparatur,
4. Planung von Messen, Prüfen und Qualitätskontrolle,
5. Oberflächentechnik,
6. Entwicklung, Konstruktion und Arbeitsvorbereitung,
7. Montage/Demontageplanung und
8. andere fachrichtungsbezogene Tätigkeiten

Näheres regelt die Praktikumsordnung für den Bachelor- und Masterstudiengang Maschinenbau der KIT-Fakultät für Maschinenbau.

(4) Über die Anerkennung des Berufspraktikums entscheidet das Praktikantenamt der KIT-Fakultät für Maschinenbau. Zur Anerkennung ist die Vorlage eines Tätigkeitsnachweises des Unternehmens (Zeugnis) im Original, das Dauer und Art der Tätigkeit während des Praktikums beschreibt, erforderlich. Tätigkeiten, die an Universitäten, gleichgestellten Hochschulen oder in vergleichbaren Forschungseinrichtungen durchgeführt wurden, werden grundsätzlich nicht als Fachpraktikum anerkannt.

(5) Liegt das Berufspraktikum bis zum Zeitpunkt der Antragsstellung noch nicht vor, kann die/der Bewerber/in im Einzelfall trotzdem unter der Auflage zugelassen werden, dass sie/er das Berufspraktikum bis zum Ende des Prüfungszeitraums des dritten Fachsemesters, spätestens aber bei der Anmeldung der Masterarbeit, nachweist. Eine etwaige Auflage wird von der Zulassungskommission festgesetzt und der/dem Bewerber/in im Rahmen der Zulassung mitgeteilt.

§ 7 Mindestkenntnisse und Mindestleistungen

(1) Die Zulassung zum Masterstudiengang Maschinenbau setzt den Nachweis voraus, dass sich der/die Bewerber/in mindestens in folgenden Fächern Fähigkeiten erworben hat, die nach Maßgabe der Lernziele, Inhalte und Leistungspunkte entsprechend des aktuellen Modulhandbuchs des Bachelorstudiengangs Maschinenbau zu denen im Bachelorstudiengang Maschinenbau am KIT gleichwertig sind:

1. Höhere Mathematik
2. Technische Thermodynamik und Wärmeübertragung
3. Technische Mechanik
4. Maschinenkonstruktionslehre
5. Werkstoffkunde
6. Strömungslehre
7. Mess- und Regelungstechnik
8. Elektrotechnik
9. Informatik.

Über die Gleichwertigkeit nach Satz 1 entscheidet die Zugangskommission des Masterstudiengangs Maschinenbau im Benehmen mit dem Prüfungsausschuss des Masterstudiengangs Maschinenbau.

(2) Sofern Bewerber die unter Absatz 1 beschriebenen Fähigkeiten nicht nachweisen können, können sie dennoch in den Studiengang immatrikuliert werden, sofern sie die für den Studiengang erforderlichen Fähigkeiten durch Bestehen einer schriftlichen Aufnahmeprüfung gemäß Anlage 1 am KIT nachweisen. Für einen erfolgreichen Nachweis darf die erfolgreiche Teilnahme an der Aufnahmeprüfung nicht länger als vier Bewerbungsverfahren zurückliegen. Ein Bewerbungsverfahren ist die auf einen bestimmten Studienbeginn bezogene Vergabe von Studienplätzen.

§ 8 Immatrikulationsentscheidung

(1) Die Entscheidung über das Erfüllen der Zugangsvoraussetzungen und die Immatrikulation trifft die/der Präsident/in auf Vorschlag der Zugangskommission.

(2) Die Immatrikulation ist zu versagen, wenn

a) die Bewerbungsunterlagen nicht fristgemäß im Sinne des § 2 oder nicht vollständig im Sinne des § 3 vorgelegt wurden,

b) die in § 5 geregelten Voraussetzungen nicht erfüllt sind,

c) im Studiengang Maschinenbau oder in einem verwandten Studiengang mit im Wesentlichen gleichem Inhalt eine nach der Prüfungsordnung erforderliche Prüfung endgültig nicht bestanden wurde oder der Prüfungsanspruch aus sonstigen Gründen nicht mehr besteht (§ 60 Abs. 2 Nr. 2 LHG, § 9 Abs. 2 HZG).

Im Fall des § 3 Abs. 3 kann die Immatrikulation unter dem Vorbehalt zugesichert werden, dass der endgültige Nachweis über den Bachelorabschluss unverzüglich, spätestens bis zwei Monate nach Beginn des Semesters, für das die Immatrikulation beantragt wurde, nachgereicht wird. Wird der Nachweis nicht fristgerecht erbracht, erlischt die Zusicherung, und eine Immatrikulation erfolgt nicht. Hat die/der Bewerber/in die Fristüberschreitung nicht zu vertreten, hat sie/er dies gegenüber der Zugangskommission zu belegen und schriftlich nachzuweisen. Die Zugangskommission kann im begründeten Einzelfall die Frist für das Nachreichen des endgültigen Zeugnisses verlängern.

(3) Erfüllt die/der Bewerber/in die Zugangsvoraussetzungen nicht und/oder kann sie/er nicht immatrikuliert werden, wird ihr/ihm das Ergebnis des Zugangsverfahrens schriftlich mitgeteilt. Der Bescheid ist zu begründen und mit einer Rechtsbehelfsbelehrung zu versehen.

(4) Über den Ablauf des Zugangsverfahrens ist eine Niederschrift anzufertigen.

(5) Im Übrigen bleiben die allgemein für das Zulassungs- und Immatrikulationsverfahren geltenden Bestimmungen in der Zulassungs- und Immatrikulationsordnung des KIT unberührt.

§ 9 Inkrafttreten

Diese Satzung tritt am Tage nach ihrer Bekanntmachung in den Amtlichen Bekanntmachungen des KIT in Kraft. Sie gilt erstmals für das Bewerbungsverfahren zum Sommersemester 2018.

Gleichzeitig tritt die Satzung für das hochschuleigene Zulassungsverfahren im Masterstudiengang Maschinenbau an der Universität Karlsruhe (TH) vom 28. Mai 2008 (Amtliche Bekanntmachungen des KIT Nr. 22 vom 28. Mai 2008), zuletzt geändert durch Satzung vom 04. August 2015 (Amtliche Bekanntmachungen des KIT Nr. 63 vom 06. August 2015) außer Kraft.

Karlsruhe, den. 22. November 2017

Prof. Dr. Holger Hanselka
(Präsident)

Anlage 1

Aufnahmeprüfung

1. Zweck

Die Aufnahmeprüfung soll zeigen, dass die/der Bewerber/in geeignet ist, den Masterstudiengang Maschinenbau erfolgreich zu absolvieren. Die Eignungsfeststellung erfolgt nach Maßgabe des Berufsbildes des Berufes/der Berufe, die dem Abschlussziel typischerweise folgen und anhand von Qualifikationen, die denen, welche im Bachelorstudiengang Maschinenbau am KIT erworben werden können, entsprechen.

2. Anmeldung zur Prüfung

2.1 Der Antrag auf Zulassung zur Aufnahmeprüfung erfolgt schriftlich bis spätestens 14 Tage vor dem Termin der Aufnahmeprüfung bei der KIT-Fakultät für Maschinenbau.

2.2 Dem Antrag ist der Nachweis über die Bewerbung für den Masterstudiengang Maschinenbau am KIT beizufügen.

2.3 Die Entscheidung über die Zulassung zur Aufnahmeprüfung gemäß Nr. 3 trifft die Zugangskommission der KIT-Fakultät für Maschinenbau (§ 4). Zur Aufnahmeprüfung zugelassene Bewerber erhalten eine Anmeldebestätigung.

3. Zulassung zur Prüfung

3.1 An der Aufnahmeprüfung nimmt nur teil, wer

a) sich ordnungsgemäß zur Aufnahmeprüfung angemeldet hat,

b) sich gemäß § 3 form- und fristgerecht für den Masterstudiengang Maschinenbau beworben hat und

c) erklärt, dass er nicht bereits mehr als einmal an einer Aufnahmeprüfung am KIT im Masterstudiengang Maschinenbau erfolglos teilgenommen hat.

3.2 Die Teilnahme ist zu versagen, wenn die unter 3.1 genannten Voraussetzungen nicht erfüllt sind.

4. Durchführung

4.1 Die genauen Termine sowie der Ort der Aufnahmeprüfung werden spätestens sechs Wochen vor dem Prüfungstermin durch das KIT auf den Internetseiten der KIT-Fakultät für Maschinenbau bekannt gegeben.

4.2 Die Aufnahmeprüfung findet in schriftlicher Form statt und dauert 90 Minuten. Sie besteht aus vier Prüfungsteilen, die Fähigkeiten aus in § 7 Abs. 1 genannten Bereichen ermitteln und zu gleichen Teilen mit 25 Punkten bewertet werden. Die mit der Aufnahmeprüfung maximal erreichbare Punktzahl beträgt 100 Punkte. Die Aufnahmeprüfung kann zu Teilen auch im Wege des Antwort-Wahl-Verfahrens durchgeführt werden. In diesem Fall findet die Satzung zur Durchführung von Antwort-Wahl-Verfahren Anwendung.

4.3 Zur Bewertung der Aufnahmeprüfung setzt die Zugangskommission (§ 4) eine Prüfungskommission ein. Sie besteht aus mindestens zwei stimmberechtigten Mitgliedern, einem/einer Hochschullehrer/in / leitenden/leitender Wissenschaftler/in gemäß § 14 Abs. 3 Ziff. 1 KITG / Privatdozentin bzw. -dozenten, und einer akademischen Mitarbeiterin/ einem akademischen Mitarbeiter nach § 52 LHG / wissenschaftlichen Mitarbeiterin/wissenschaftlichen Mitarbeiter gemäß § 14 Abs. 3 Ziff. 2 KITG sowie einer /einem Studierenden mit beratender Stimme. Die Amtszeit der nicht studentischen Kommissionsmitglieder beträgt zwei Jahre, die des studentischen Kommissionsmitgliedes ein Jahr. Eine Wiederbestellung ist möglich.

4.4 Die Aufnahmeprüfung wird mit 0 Punkten bewertet, wenn die/der Bewerber/in zum Prüfungstermin ohne wichtigen Grund nicht erscheint. Tritt die/der Bewerber/in nach Ausgabe der Prüfungsaufgaben von der Aufnahmeprüfung zurück, wird sie/er nach dem bis zu diesem Zeitpunkt erzielten Ergebnis bewertet. Die/der Bewerber/in ist berechtigt, erneut an einer Aufnahmeprüfung teilzunehmen, wenn unverzüglich nach dem Termin der Aufnahmeprüfung dem KIT angezeigt und glaubhaft gemacht wird, dass für das Fehlen am Termin oder den Rücktritt von der Prüfung ein wichtiger Grund vorgelegen hat; bei Krankheit ist ein ärztliches Attest vorzulegen.

4.5 Versucht die/der Bewerber/in das Ergebnis der Aufnahmeprüfung durch Täuschung oder Benutzung nicht zugelassener Hilfsmittel zu beeinflussen, wird die Prüfung mit 0 Punkten bewertet. Ein/e Bewerber/in, die/der den ordnungsgemäßen Ablauf der Prüfung stört, kann von dem jeweiligen Aufsichtsführenden von der Fortsetzung der Prüfung ausgeschlossen werden; in diesem Fall wird die Prüfung mit 0 Punkten bewertet.

4.6 Das KIT übernimmt keine Kosten, die durch die Aufnahmeprüfung für die Bewerber/innen entstehen.

5. Ermittlung der Eignung und Mitteilung des Ergebnisses

5.1 Die Aufnahmeprüfung ist bestanden, wenn die/der Bewerber/in mindestens 75 Punkte, dabei mindestens 15 Punkte in jedem der vier Teilbereiche erreicht.

5.2 Die Zugangskommission (§ 4) stellt die Eignung der Bewerberin/ des Bewerbers auf Vorschlag der Prüfungskommission fest. Das Ergebnis der Aufnahmeprüfung wird den Bewerberinnen/Bewerbern schriftlich durch die KIT-Fakultät für Maschinenbau mitgeteilt. Der Bescheid ist zu begründen und mit einer Rechtsbehelfsbelehrung zu versehen.

6. Wiederholung

Bewerber/innen, die einmal erfolglos an einer Aufnahmeprüfung für den Masterstudiengang Maschinenbau am KIT teilgenommen haben, können sich frühestens im nächsten Bewerbungszeitraum einmalig erneut zur Aufnahmeprüfung für diesen Studiengang anmelden. Eine weitere Wiederholung ist nicht möglich.

Karlsruher Institut für Technologie

Die Forschungsuniversität in der Helmholtz-Gemeinschaft

Amtliche Bekanntmachung

2018 **Ausgegeben Karlsruhe, den 28. November 2018** **Nr. 63**

I n h a l t **Seite**

311

Satzung zur Änderung der Satzung für den Zugang zu dem Masterstudiengang Maschinenbau am Karlsruher Institut für Technologie (KIT)

vom 28. November 2018

Aufgrund von § 10 Abs. 2 Ziff. 6 und § 20 des KIT-Gesetzes (KITG) in der Fassung vom 14. Juli 2009 (GBl. S. 317 ff), zuletzt geändert durch Artikel 2 des Gesetzes zur Weiterentwicklung des Hochschulrechts (HRWeitEG) vom 13. März 2018 (GBl S. 85, 94), §§ 59 Abs. 1, 63 Abs. 2 des Landeshochschulgesetzes (LHG) in der Fassung vom 1. Januar 2005 (GBl. S. 1 ff), zuletzt geändert durch Artikel 1 des Gesetzes zur Weiterentwicklung des Hochschulrechts (HRWeitEG) vom 13. März 2018 (GBl S. 85 ff.), hat der KIT-Senat in seiner Sitzung am 19. November 2018 die nachstehende Satzung beschlossen.

Artikel 1

1. **§ 3 Abs. 2 Ziff. 3 wird wie folgt geändert:**

   Nach dem Wort „Berufspraktikum“ werden die Worte „welches durch das Praktikantenamt der KIT-Fakultät für Maschinenbau anerkannt wurde“ gestrichen.

2. **§ 5 Abs. 1 Ziff. 3 wird wie folgt geändert:**

   Nach dem Wort „notwendige“ werden die Worte „durch den Bachelorabschluss vermittelte“ gestrichen.

3. **§ 5 Abs. 1 Ziff. 5 Buchst. b) erhält folgende Fassung:**

   „b) ausreichenden englischen Sprachkenntnisse, die mindestens dem Niveau B2 des Gemeinsamen Europäischen Referenzrahmens für Sprachen (GER) oder gleichwertig entsprechen, nachgewiesen beispielsweise durch einen der folgenden international anerkannten Tests:
   - aa) Test of English as Foreign Language (TOEFL) mit mindestens 550 Punkten im paper-based Test, oder 88 Punkten im internet-based Test oder
   - bb) IELTS mit einem Gesamtergebnis von mindestens 6.5 und keiner Section unter 5.5.

   Der Nachweis englischer Sprachkenntnisse entfällt für Bewerber/innen, die ihren Bachelorabschluss in einem englischsprachigen Studiengang oder im englischsprachigen Ausland erworben haben. Die offizielle Sprache des Studienprogramms muss auf dem Abschlusszeugnis, dessen Ergänzung, im Transcript of Records oder in einer entsprechenden Bescheinigung der Hochschule vermerkt sein.“

4. **§ 6 Abs. 5 erhält folgende Fassung:**

   „**(5)** Liegt das Berufspraktikum oder die Anerkennung des Praktikums bis zum Zeitpunkt der Antragsstellung noch nicht vor, kann die/der Bewerber/in im Einzelfall trotzdem unter der Auflage zugelassen werden, dass sie/er das Berufspraktikum bis zum Ende des Prüfungszeitraums des dritten Fachsemesters, spätestens aber bei der Anmeldung der Masterarbeit, nachweist. Eine etwaige Auflage wird von der Zulassungskommission festgesetzt und der/dem Bewerber/in im Rahmen der Zulassung mitgeteilt.“

5. **Anlage 1 Ziff. 5.1 erhält folgende Fassung:**
„5.1 Die Aufnahmeprüfung ist bestanden, wenn die/der Bewerber/in mindestens 50 Punkte, dabei mindestens 12 Punkte in jedem der vier Teilbereiche erreicht."

Artikel 2

Diese Satzung tritt am Tage nach ihrer Bekanntmachung in den Amtlichen Bekanntmachungen des KIT in Kraft. Sie gilt erstmals für das Bewerbungsverfahren zum Sommersemester 2019.

Karlsruhe, 28. November 2018

gez. Prof. Dr. Holger Hanselka
(Präsident)

Karlsruher Institut für Technologie

Die Forschungsuniversität in der Helmholtz-Gemeinschaft

Amtliche Bekanntmachung

2019 **Ausgegeben Karlsruhe, den 29. Juli 2019** **Nr. 38**

I n h a l t **Seite**

Zweite Satzung zur Änderung der Satzung für den Zugang zu dem Masterstudiengang Maschinenbau am Karlsruher Institut für Technologie (KIT)

vom 29. Juli 2019

Aufgrund von § 10 Abs. 2 Ziff. 6 und § 20 des KIT-Gesetzes (KITG) in der Fassung vom 14. Juli 2009 (GBl. S. 317 ff), zuletzt geändert durch Artikel 2 des Gesetzes zur Weiterentwicklung des Hochschulrechts (HRWeitEG) vom 13. März 2018 (GBl S. 85, 94), §§ 59 Abs. 1, 63 Abs. 2 des Landeshochschulgesetzes (LHG) in der Fassung vom 1. Januar 2005 (GBl. S. 1 ff), zuletzt geändert durch Artikel 1 des Gesetzes zur Weiterentwicklung des Hochschulrechts (HRWeitEG) vom 13. März 2018 (GBl S. 85 ff.), hat der KIT-Senat in seiner Sitzung am 15. Juli 2019 die nachstehende Satzung beschlossen.

Artikel 1
Anlage 1 Ziff. 5.1 der Satzung für den Zugang zu dem Masterstudiengang Maschinenbau am Karlsruher Institut für Technologie (KIT) vom 22. November 2017 (Amtliche Bekanntmachung des KIT Nr. 68 vom 24. November 2017), zuletzt geändert durch Satzung vom 28. November 2018 (Amtliche Bekanntmachung des KIT Nr. 63 vom 28. November 2018), erhält folgende Fassung:

„5.1 Die Aufnahmeprüfung ist bestanden, wenn die/der Bewerber/in mindestens 50 Punkte erreicht.“

Artikel 2
Diese Satzung tritt am Tage nach ihrer Bekanntmachung in den Amtlichen Bekanntmachungen des KIT in Kraft. Sie gilt erstmals für das Bewerbungsverfahren zum Wintersemester 2019/20.

Karlsruhe, 29. Juli 2019

gez. Prof. Dr. Holger Hanselka
(Präsident)

9 Field of study structure

Mandatory	
Master Thesis	30 CR
Advanced Engineering Fundamentals	50 CR
Specialization	40 CR

9.1 Master Thesis

Credits
30

Mandatory		
M-MACH-102858	Master's Thesis	30 CR

9.2 Advanced Engineering Fundamentals

Credits
50

Mandatory		
M-MACH-102593	Product Development - Dimensioning of Components	7 CR
M-MACH-102718	Product Development - Methods of Product Development	6 CR
M-MACH-102592	Modeling and Simulation	7 CR
M-MACH-102594	Mathematical Methods	6 CR
M-MACH-102591	Laboratory Course	4 CR
M-MACH-102597	Compulsory Elective Module Mechanical Engineering	8 CR
M-MACH-102595	Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering	6 CR
M-MACH-102596	Compulsory Elective Subject Economics/Law	4 CR
M-MACH-102824	Key Competences	2 CR

9.3 Specialization

Credits
40

Election block: Vertiefungsrichtung (1 item)	
Specialization: General Mechanical Engineering	40 CR
Specialization: Energy- and Environment Engineering	40 CR
Specialization: Vehicle Technology	40 CR
Specialization: Mechatronics and Microsystems Technology	40 CR
Specialization: Product Development and Engineering Design	40 CR
Specialization: Production Technology	40 CR
Specialization: Theoretical Mechanical Engineering	40 CR
Specialization: Materials and Structures for High Performance Systems	40 CR

9.3.1 Specialization: General Mechanical Engineering

Part of: Specialization

Credits
40

Mandatory		
M-MACH-102405	Fundamentals and Methods of General Mechanical Engineering	8 CR
Election block: Schwerpunkte (2 items)		
M-MACH-102649	Major Field: Advanced Materials Modelling	16 CR
M-MACH-102598	Major Field: Advanced Mechatronics	16 CR
M-MACH-102646	Major Field: Applied Mechanics	16 CR
M-MACH-102599	Major Field: Powertrain Systems	16 CR
M-MACH-102601	Major Field: Automation Technology	16 CR
M-MACH-102641	Major Field: Rail System Technology	16 CR
M-MACH-102604	Major Field: Computational Mechanics	16 CR
M-MACH-102642	Major Field: Development of Innovative Appliances and Power Tools	16 CR
M-MACH-102605	Major Field: Engineering Design	16 CR
M-MACH-102606	Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics	16 CR
M-MACH-102643	Major Field: Fusion Technology	16 CR
M-MACH-102648	Major Field: Energy Technology for Buildings	16 CR
M-MACH-102623	Major Field: Fundamentals of Energy Technology	16 CR
M-MACH-102624	Major Field: Information Technology	16 CR
M-MACH-102625	Major Field: Information Technology of Logistic Systems	16 CR
M-MACH-102626	Major Field: Integrated Product Development	16 CR
M-MACH-102608	Major Field: Nuclear Energy	16 CR
M-MACH-102609	Major Field: Cognitive Technical Systems	16 CR
M-MACH-102607	Major Field: Vehicle Technology	16 CR
M-MACH-102627	Major Field: Energy Converting Engines	16 CR
M-MACH-102610	Major Field: Power Plant Technology	16 CR
M-MACH-102628	Major Field: Lightweight Construction	16 CR
M-MACH-102613	Major Field: Lifecycle Engineering	16 CR
M-MACH-102629	Major Field: Logistics and Material Flow Theory	16 CR
M-MACH-102611	Major Field: Materials Science and Engineering	16 CR
M-MACH-102614	Major Field: Mechatronics	16 CR
M-MACH-102615	Major Field: Medical Technology	16 CR
M-MACH-102600	Major Field: Man - Technology - Organisation	16 CR
M-MACH-102647	Major Field: Microactuators and Microsensors	16 CR
M-MACH-102616	Major Field: Microsystem Technology	16 CR

M-MACH-102630	Major Field: Mobile Machines	16 CR
M-MACH-104434	Major Field: Modeling and Simulation in Dynamics	16 CR
M-MACH-102612	Major Field: Modeling and Simulation in Energy- and Fluid Engineering	16 CR
M-MACH-102632	Major Field: Polymer Engineering	16 CR
M-MACH-102618	Major Field: Production Technology	16 CR
M-MACH-102633	Major Field: Robotics	16 CR
M-MACH-104443	Major Field: Vibration Theory	16 CR
M-MACH-102634	Major Field: Fluid Mechanic	16 CR
M-MACH-102619	Major Field: Technical Ceramics and Powder Materials	16 CR
M-MACH-102640	Major Field: Technical Logistics	16 CR
M-MACH-102635	Major Field: Engineering Thermodynamics	16 CR
M-MACH-102636	Major Field: Thermal Turbomachines	16 CR
M-MACH-102637	Major Field: Tribology	16 CR
M-MACH-102650	Major Field: Combustion Engines Based Powertrains	16 CR
M-MACH-102602	Major Field: Reliability in Mechanical Engineering	16 CR

9.3.2 Specialization: Energy- and Environment Engineering

Part of: Specialization

Credits 40

Mandatory		
M-MACH-102575	Fundamentals and Methods of Energy and Environmental Engineering	8 CR
M-MACH-102623	Major Field: Fundamentals of Energy Technology	16 CR
Election block: Schwerpunkt (1 item)		
M-MACH-102598	Major Field: Advanced Mechatronics	16 CR
M-MACH-102646	Major Field: Applied Mechanics	16 CR
M-MACH-102601	Major Field: Automation Technology	16 CR
M-MACH-102642	Major Field: Development of Innovative Appliances and Power Tools	16 CR
M-MACH-102605	Major Field: Engineering Design	16 CR
M-MACH-102643	Major Field: Fusion Technology	16 CR
M-MACH-102648	Major Field: Energy Technology for Buildings	16 CR
M-MACH-102624	Major Field: Information Technology	16 CR
M-MACH-104323	Major Field: Innovation and Entrepreneurship	16 CR
M-MACH-102626	Major Field: Integrated Product Development	16 CR
M-MACH-102608	Major Field: Nuclear Energy	16 CR
M-MACH-102627	Major Field: Energy Converting Engines	16 CR
M-MACH-102610	Major Field: Power Plant Technology	16 CR
M-MACH-102628	Major Field: Lightweight Construction	16 CR
M-MACH-102611	Major Field: Materials Science and Engineering	16 CR
M-MACH-102614	Major Field: Mechatronics	16 CR
M-MACH-102600	Major Field: Man - Technology - Organisation	16 CR
M-MACH-102647	Major Field: Microactuators and Microsensors	16 CR
M-MACH-102616	Major Field: Microsystem Technology	16 CR
M-MACH-104434	Major Field: Modeling and Simulation in Dynamics	16 CR
M-MACH-102612	Major Field: Modeling and Simulation in Energy- and Fluid Engineering	16 CR
M-MACH-102632	Major Field: Polymer Engineering	16 CR
M-MACH-104443	Major Field: Vibration Theory	16 CR
M-MACH-102634	Major Field: Fluid Mechanic	16 CR
M-MACH-102619	Major Field: Technical Ceramics and Powder Materials	16 CR
M-MACH-102635	Major Field: Engineering Thermodynamics	16 CR
M-MACH-102636	Major Field: Thermal Turbomachines	16 CR

M-MACH-102637	Major Field: Tribology	16 CR
M-MACH-102650	Major Field: Combustion Engines Based Powertrains	16 CR
M-MACH-102602	Major Field: Reliability in Mechanical Engineering	16 CR

9.3.3 Specialization: Vehicle Technology

Part of: Specialization

Credits 40

Mandatory		
M-MACH-102739	Fundamentals and Methods of Automotive Engineering	8 CR
Election block: Schwerpunkt (p) (between 1 and 2 items)		
M-MACH-102641	Major Field: Rail System Technology	16 CR
M-MACH-102607	Major Field: Vehicle Technology	16 CR
M-MACH-102630	Major Field: Mobile Machines	16 CR
M-MACH-102650	Major Field: Combustion Engines Based Powertrains	16 CR
Election block: Schwerpunkt (between 0 and 1 items)		
M-MACH-102598	Major Field: Advanced Mechatronics	16 CR
M-MACH-102646	Major Field: Applied Mechanics	16 CR
M-MACH-102599	Major Field: Powertrain Systems	16 CR
M-MACH-102601	Major Field: Automation Technology	16 CR
M-MACH-102604	Major Field: Computational Mechanics	16 CR
M-MACH-102642	Major Field: Development of Innovative Appliances and Power Tools	16 CR
M-MACH-102605	Major Field: Engineering Design	16 CR
M-MACH-102606	Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics	16 CR
M-MACH-102623	Major Field: Fundamentals of Energy Technology	16 CR
M-MACH-102624	Major Field: Information Technology	16 CR
M-MACH-102626	Major Field: Integrated Product Development	16 CR
M-MACH-102609	Major Field: Cognitive Technical Systems	16 CR
M-MACH-102627	Major Field: Energy Converting Engines	16 CR
M-MACH-102628	Major Field: Lightweight Construction	16 CR
M-MACH-102613	Major Field: Lifecycle Engineering	16 CR
M-MACH-102611	Major Field: Materials Science and Engineering	16 CR
M-MACH-102614	Major Field: Mechatronics	16 CR
M-MACH-102647	Major Field: Microactuators and Microsensors	16 CR
M-MACH-102616	Major Field: Microsystem Technology	16 CR
M-MACH-104434	Major Field: Modeling and Simulation in Dynamics	16 CR
M-MACH-102612	Major Field: Modeling and Simulation in Energy- and Fluid Engineering	16 CR
M-MACH-102632	Major Field: Polymer Engineering	16 CR
M-MACH-102618	Major Field: Production Technology	16 CR
M-MACH-104443	Major Field: Vibration Theory	16 CR
M-MACH-102634	Major Field: Fluid Mechanic	16 CR
M-MACH-102619	Major Field: Technical Ceramics and Powder Materials	16 CR
M-MACH-102635	Major Field: Engineering Thermodynamics	16 CR
M-MACH-102636	Major Field: Thermal Turbomachines	16 CR
M-MACH-102637	Major Field: Tribology	16 CR
M-MACH-102602	Major Field: Reliability in Mechanical Engineering	16 CR

9.3.4 Specialization: Mechatronics and Microsystems Technology

Part of: Specialization

Credits 40

Mandatory		
M-MACH-102740	Fundamentals and Methods of Mechatronics and Microsystem Technology	8 CR
Election block: Schwerpunkt (p) (between 1 and 2 items)		
M-MACH-102598	Major Field: Advanced Mechatronics	16 CR
M-MACH-102601	Major Field: Automation Technology	16 CR
M-MACH-102614	Major Field: Mechatronics	16 CR
M-MACH-102616	Major Field: Microsystem Technology	16 CR
M-MACH-102633	Major Field: Robotics	16 CR
Election block: Schwerpunkt (between 0 and 1 items)		
M-MACH-102646	Major Field: Applied Mechanics	16 CR
M-MACH-102641	Major Field: Rail System Technology	16 CR
M-MACH-102604	Major Field: Computational Mechanics	16 CR
M-MACH-102606	Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics	16 CR
M-MACH-102623	Major Field: Fundamentals of Energy Technology	16 CR
M-MACH-102624	Major Field: Information Technology	16 CR
M-MACH-102609	Major Field: Cognitive Technical Systems	16 CR
M-MACH-102613	Major Field: Lifecycle Engineering	16 CR
M-MACH-102611	Major Field: Materials Science and Engineering	16 CR
M-MACH-102615	Major Field: Medical Technology	16 CR
M-MACH-102647	Major Field: Microactuators and Microsensors	16 CR
M-MACH-102630	Major Field: Mobile Machines	16 CR
M-MACH-104434	Major Field: Modeling and Simulation in Dynamics	16 CR
M-MACH-102612	Major Field: Modeling and Simulation in Energy- and Fluid Engineering	16 CR
M-MACH-104443	Major Field: Vibration Theory	16 CR
M-MACH-102635	Major Field: Engineering Thermodynamics	16 CR
M-MACH-102637	Major Field: Tribology	16 CR
M-MACH-102650	Major Field: Combustion Engines Based Powertrains	16 CR
M-MACH-102602	Major Field: Reliability in Mechanical Engineering	16 CR

9.3.5 Specialization: Product Development and Engineering Design

Part of: Specialization

Credits 40

Mandatory		
M-MACH-102741	Fundamentals and Methods of Product Development and Construction	8 CR
Election block: Schwerpunkt (p) (between 1 and 2 items)		
M-MACH-102642	Major Field: Development of Innovative Appliances and Power Tools	16 CR
M-MACH-102626	Major Field: Integrated Product Development	16 CR
M-MACH-102613	Major Field: Lifecycle Engineering	16 CR
Election block: Schwerpunkt (between 0 and 1 items)		
M-MACH-102598	Major Field: Advanced Mechatronics	16 CR
M-MACH-102646	Major Field: Applied Mechanics	16 CR
M-MACH-102599	Major Field: Powertrain Systems	16 CR
M-MACH-102601	Major Field: Automation Technology	16 CR
M-MACH-102641	Major Field: Rail System Technology	16 CR
M-MACH-102604	Major Field: Computational Mechanics	16 CR
M-MACH-102605	Major Field: Engineering Design	16 CR
M-MACH-102606	Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics	16 CR
M-MACH-102623	Major Field: Fundamentals of Energy Technology	16 CR
M-MACH-102624	Major Field: Information Technology	16 CR
M-MACH-102625	Major Field: Information Technology of Logistic Systems	16 CR

M-MACH-102609	Major Field: Cognitive Technical Systems	16 CR
M-MACH-102607	Major Field: Vehicle Technology	16 CR
M-MACH-102627	Major Field: Energy Converting Engines	16 CR
M-MACH-102610	Major Field: Power Plant Technology	16 CR
M-MACH-102628	Major Field: Lightweight Construction	16 CR
M-MACH-102629	Major Field: Logistics and Material Flow Theory	16 CR
M-MACH-102611	Major Field: Materials Science and Engineering	16 CR
M-MACH-102614	Major Field: Mechatronics	16 CR
M-MACH-102615	Major Field: Medical Technology	16 CR
M-MACH-102600	Major Field: Man - Technology - Organisation	16 CR
M-MACH-102647	Major Field: Microactuators and Microsensors	16 CR
M-MACH-102616	Major Field: Microsystem Technology	16 CR
M-MACH-102630	Major Field: Mobile Machines	16 CR
M-MACH-104434	Major Field: Modeling and Simulation in Dynamics	16 CR
M-MACH-102612	Major Field: Modeling and Simulation in Energy- and Fluid Engineering	16 CR
M-MACH-102632	Major Field: Polymer Engineering	16 CR
M-MACH-102618	Major Field: Production Technology	16 CR
M-MACH-102633	Major Field: Robotics	16 CR
M-MACH-104443	Major Field: Vibration Theory	16 CR
M-MACH-102634	Major Field: Fluid Mechanic	16 CR
M-MACH-102619	Major Field: Technical Ceramics and Powder Materials	16 CR
M-MACH-102640	Major Field: Technical Logistics	16 CR
M-MACH-102635	Major Field: Engineering Thermodynamics	16 CR
M-MACH-102637	Major Field: Tribology	16 CR
M-MACH-102650	Major Field: Combustion Engines Based Powertrains	16 CR
M-MACH-102602	Major Field: Reliability in Mechanical Engineering	16 CR

9.3.6 Specialization: Production Technology

Part of: Specialization

Credits 40

Mandatory		
M-MACH-102742	Fundamentals and Methods of Production Technology	8 CR
Election block: Schwerpunkt (p) (between 1 and 2 items)		
M-MACH-102613	Major Field: Lifecycle Engineering	16 CR
M-MACH-102629	Major Field: Logistics and Material Flow Theory	16 CR
M-MACH-102600	Major Field: Man - Technology - Organisation	16 CR
M-MACH-102618	Major Field: Production Technology	16 CR
Election block: Schwerpunkt (between 0 and 1 items)		
M-MACH-102598	Major Field: Advanced Mechatronics	16 CR
M-MACH-102646	Major Field: Applied Mechanics	16 CR
M-MACH-102599	Major Field: Powertrain Systems	16 CR
M-MACH-102601	Major Field: Automation Technology	16 CR
M-MACH-102642	Major Field: Development of Innovative Appliances and Power Tools	16 CR
M-MACH-102605	Major Field: Engineering Design	16 CR
M-MACH-102624	Major Field: Information Technology	16 CR
M-MACH-102625	Major Field: Information Technology of Logistic Systems	16 CR
M-MACH-102626	Major Field: Integrated Product Development	16 CR
M-MACH-102609	Major Field: Cognitive Technical Systems	16 CR
M-MACH-102628	Major Field: Lightweight Construction	16 CR
M-MACH-102611	Major Field: Materials Science and Engineering	16 CR

M-MACH-102614	Major Field: Mechatronics	16 CR
M-MACH-102647	Major Field: Microactuators and Microsensors	16 CR
M-MACH-102616	Major Field: Microsystem Technology	16 CR
M-MACH-102630	Major Field: Mobile Machines	16 CR
M-MACH-104434	Major Field: Modeling and Simulation in Dynamics	16 CR
M-MACH-102632	Major Field: Polymer Engineering	16 CR
M-MACH-102633	Major Field: Robotics	16 CR
M-MACH-104443	Major Field: Vibration Theory	16 CR
M-MACH-102640	Major Field: Technical Logistics	16 CR
M-MACH-102637	Major Field: Tribology	16 CR
M-MACH-102602	Major Field: Reliability in Mechanical Engineering	16 CR

9.3.7 Specialization: Theoretical Mechanical Engineering

Part of: Specialization

Credits 40

Mandatory		
M-MACH-102743	Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering	8 CR
Election block: Schwerpunkt (p) (between 1 and 2 items)		
M-MACH-102646	Major Field: Applied Mechanics	16 CR
M-MACH-102604	Major Field: Computational Mechanics	16 CR
M-MACH-104434	Major Field: Modeling and Simulation in Dynamics	16 CR
M-MACH-104443	Major Field: Vibration Theory	16 CR
M-MACH-102634	Major Field: Fluid Mechanic	16 CR
Election block: Schwerpunkt (between 0 and 1 items)		
M-MACH-102649	Major Field: Advanced Materials Modelling	16 CR
M-MACH-102598	Major Field: Advanced Mechatronics	16 CR
M-MACH-102601	Major Field: Automation Technology	16 CR
M-MACH-102606	Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics	16 CR
M-MACH-102643	Major Field: Fusion Technology	16 CR
M-MACH-102624	Major Field: Information Technology	16 CR
M-MACH-102608	Major Field: Nuclear Energy	16 CR
M-MACH-102609	Major Field: Cognitive Technical Systems	16 CR
M-MACH-102611	Major Field: Materials Science and Engineering	16 CR
M-MACH-102614	Major Field: Mechatronics	16 CR
M-MACH-102633	Major Field: Robotics	16 CR
M-MACH-102635	Major Field: Engineering Thermodynamics	16 CR
M-MACH-102636	Major Field: Thermal Turbomachines	16 CR
M-MACH-102637	Major Field: Tribology	16 CR
M-MACH-102602	Major Field: Reliability in Mechanical Engineering	16 CR

9.3.8 Specialization: Materials and Structures for High Performance Systems

Part of: Specialization

Credits 40

Mandatory		
M-MACH-102744	Fundamentals and Methods of Materials and Structures for High Performance Systems	8 CR
Election block: Schwerpunkt (p) (between 1 and 2 items)		
M-MACH-102611	Major Field: Materials Science and Engineering	16 CR
M-MACH-102602	Major Field: Reliability in Mechanical Engineering	16 CR
Election block: Schwerpunkt (between 0 and 1 items)		

M-MACH-102649	Major Field: Advanced Materials Modelling	16 CR
M-MACH-102646	Major Field: Applied Mechanics	16 CR
M-MACH-102628	Major Field: Lightweight Construction	16 CR
M-MACH-102632	Major Field: Polymer Engineering	16 CR
M-MACH-102619	Major Field: Technical Ceramics and Powder Materials	16 CR
M-MACH-102635	Major Field: Engineering Thermodynamics	16 CR
M-MACH-102636	Major Field: Thermal Turbomachines	16 CR
M-MACH-102637	Major Field: Tribology	16 CR

10 Modules

M 10.1 Module: Compulsory Elective Module Mechanical Engineering (MSc-Modul 04, WF) [M-MACH-102597]

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

Part of: Advanced Engineering Fundamentals

Credits	Recurrence	Language	Level	Version
8	Once	German/English	4	2

Election block: Wahlpflichtmodul Maschinenbau (2 items)			
T-MACH-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines	4 CR	Gohl
T-MACH-105528	Aerodynamics	4 CR	Frohnapfel, Ohle
T-MACH-105437	Aerothermodynamics	4 CR	Frohnapfel, Seiler
T-MACH-105238	Actuators and Sensors in Nanotechnology	4 CR	Kohl
T-MACH-105215	Applied Tribology in Industrial Product Development	4 CR	Albers, Lorentz, Matthiesen
T-MACH-105527	Applied Materials Modelling	4 CR	Gumbsch, Schulz
T-MACH-105307	Drive Train of Mobile Machines	4 CR	Geimer, Wydra
T-MACH-105390	Application of Advanced Programming Languages in Mechanical Engineering	4 CR	Weygand
T-MACH-105649	Boosting of Combustion Engines	4 CR	Kech, Kubach
T-MACH-105518	Human Factors Engineering I	4 CR	Deml
T-MACH-105519	Human Factors Engineering II	4 CR	Deml
T-MACH-105308	Atomistic Simulations and Molecular Dynamics	4 CR	Brandl, Gumbsch, Schneider
T-MACH-102141	Constitution and Properties of Wearresistant Materials	4 CR	Ulrich
T-MACH-105150	Constitution and Properties of Protective Coatings	4 CR	Ulrich
T-MACH-105381	Virtual Engineering (Specific Topics)	4 CR	Ovtcharova
T-MACH-102160	Selected Applications of Technical Logistics	4 CR	Milushev, Mittwollen
T-MACH-105428	Selected Chapters of the Combustion Fundamentals	4 CR	Maas
T-MACH-105462	Selected Problems of Applied Reactor Physics and Exercises	4 CR	Dagan
T-MACH-105310	Design of Highly Stresses Components	4 CR	Aktaa
T-MACH-105311	Design and Development of Mobile Machines	4 CR	Geimer, Siebert
T-MACH-105536	Dimensioning and Optimization of Power Train System	4 CR	Albers, Faust, Kirchner, Matthiesen
T-MACH-105217	Automation Systems	4 CR	Kaufmann
T-MACH-106424	Rail System Technology	4 CR	Gratzfeld
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-106877	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine IV	4 CR	Guber
T-MACH-102172	Bionics for Engineers and Natural Scientists	4 CR	Hölscher
T-MACH-102150	BUS-Controls	4 CR	Becker, Geimer

T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-109302	Computational Homogenization on Digital Image Data	6 CR	Schneider
T-MACH-105407	CFD in Power Engineering	4 CR	Otic
T-MACH-105314	Computational Intelligence	4 CR	Jakob, Mikut, Reischl
T-MACH-105694	Data Analytics for Engineers	5 CR	Ludwig, Mikut, Reischl
T-MACH-108719	Designing with numerical methods in product development	4 CR	Schnack
T-MACH-105540	Railways in the Transportation Market	4 CR	Gratzfeld
T-MACH-108721	Designing with Composites	4 CR	Schnack
T-MACH-105391	Finite Difference Methods for Numerial Solution of Thermal and Fluid Dynamical Problems	4 CR	Günther
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-105226	Dynamics of the Automotive Drive Train	5 CR	Fidlin
T-MACH-105320	Introduction to the Finite Element Method	4 CR	Böhlke, Langhoff
T-MACH-108718	Introduction to numerical mechanics	4 CR	Schnack
T-MACH-105525	Introduction to Nuclear Energy	4 CR	Cheng
T-MACH-105321	Introduction to Theory of Materials	4 CR	Kamlah
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-105439	Introduction to Nonlinear Vibrations	7 CR	Fidlin
T-MACH-102121	Electric Rail Vehicles	4 CR	Gratzfeld
T-MACH-102159	Elements and Systems of Technical Logistics	4 CR	Fischer, Mittwollen
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Braun, Schönung
T-MACH-105952	Energy Storage and Network Integration	4 CR	Jäger, Stieglitz
T-MACH-105408	Energy Systems I: Renewable Energy	6 CR	Dagan
T-MACH-105984	Fatigue of Welded Components and Structures	3 CR	Farajian, Gumbsch
T-MACH-105228	Organ Support Systems	4 CR	Pylatiuk
T-MACH-105512	Experimental Fluid Mechanics	4 CR	Kriegseis
T-MACH-106373	Experimental techniques in thermo- and fluid-dynamics	4 CR	Cheng
T-MACH-105152	Handling Characteristics of Motor Vehicles I	4 CR	Unrau
T-MACH-105153	Handling Characteristics of Motor Vehicles II	4 CR	Unrau
T-MACH-105154	Vehicle Comfort and Acoustics I	4 CR	Gauterin
T-MACH-105155	Vehicle Comfort and Acoustics II	4 CR	Gauterin
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning
T-MACH-105156	Vehicle Mechatronics I	4 CR	Ammon
T-MACH-107667	Solid State Reactions and Kinetics of Phase	4 CR	Franke, Seifert
T-MACH-102207	Tires and Wheel Development for Passenger Cars	4 CR	Leister
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	4 CR	Henning
T-MACH-102166	Fabrication Processes in Microsystem Technology	4 CR	Bade
T-MACH-105394	Finite Volume Methods for Fluid Flow	4 CR	Günther
T-MACH-105474	Fluid-Structure-Interaction	4 CR	Frohnapfel, Mühlhausen
T-MACH-102093	Fluid Power Systems	4 CR	Geimer, Pult
T-MACH-105411	Fusion Technology A	4 CR	Stieglitz
T-MACH-105433	Fusion Technology B	4 CR	Stieglitz
T-MACH-105444	Combined Cycle Power Plants	4 CR	Schulenberg
T-MACH-108848	Global Production and Logistics - Part 1: Global Production	4 CR	Lanza
T-MACH-105533	Gasdynamics	4 CR	Magagnato
T-MACH-105467	Microstructure Characteristics Relationships	6 CR	Gruber, Kraft
T-MACH-105157	Foundry Technology	4 CR	Wilhelm

T-MACH-105159	Global Production and Logistics - Part 2: Global Logistics	4 CR	Furmans
T-MACH-102117	Automotive Engineering II	4 CR	Gauterin, Unrau
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	4 CR	Schell
T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment	4 CR	Deutschmann, Grunwaldt, Kubach, Lox
T-MACH-105235	Principles of Medicine for Engineers	4 CR	Pylatiuk
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink
T-MACH-105324	Foundations of Nonlinear Continuum Mechanics	4 CR	Kamlah
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas, Sommerer
T-MACH-105325	Fundamentals of Combustion II	4 CR	Maas
T-MACH-105424	Optical Flow Measurement: Fundamentals and Applications	4 CR	Frohnapfel, Seiler
T-MACH-106746	Hands-on BioMEMS	4 CR	Guber
T-MACH-105398	High Performance Computing	5 CR	Nestler, Selzer
T-MACH-105459	High Temperature Materials	4 CR	Heilmaier
T-MACH-106374	Human-oriented Productivity Management: Personnel Management	4 CR	Stock
T-MACH-105425	Hydrodynamic Stability: From Order to Chaos	4 CR	Class
T-MACH-105375	Industrial Aerodynamics	4 CR	Breitling, Frohnapfel
T-MACH-105388	Introduction to Industrial Production Economics	4 CR	Dürrschnabel
T-MACH-105386	Occupational Safety and Environmental Protection	4 CR	von Kiparski
T-MACH-105404	Innovative Nuclear Systems	4 CR	Cheng
T-MACH-105466	Introduction to Neutron Cross Section Theory and Nuclear Data Generation	4 CR	Dagan
T-MACH-100287	Introduction to Ceramics	6 CR	Hoffmann
T-MACH-102182	Ceramic Processing Technology	4 CR	Binder
T-MACH-105402	Nuclear Power Plant Technology	4 CR	Badea, Cheng, Schulenberg
T-MACH-105410	Coal Fired Power Plants	4 CR	Schulenberg
T-MACH-105330	Design with Plastics	4 CR	Liedel
T-MACH-100293	Structural Materials	6 CR	Guth, Lang
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
T-MACH-110377	Advanced Methods in Strength of Materials	4 CR	Böhlke, Frohnapfel
T-MACH-105786	Contact Mechanics	4 CR	Greiner
T-MACH-105414	Cooling of Thermally High Loaded Gas Turbine Components	4 CR	Bauer, Schulz
T-MACH-105164	Laser in Automotive Engineering	4 CR	Schneider
T-MACH-105231	Leadership and Management Development	4 CR	Albers, Matthiesen, Ploch
T-MACH-102089	Logistics - Organisation, Design and Control of Logistic Systems	6 CR	Furmans
T-MACH-105165	Automotive Logistics	4 CR	Furmans
T-MACH-105426	Magnetohydrodynamics	4 CR	Bühler
T-MACH-105434	Magnet Technology of Fusion Reactors	4 CR	Fietz, Weiss
T-MACH-105440	Leadership and Conflict Management	4 CR	Hatzl
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-108957	Mathematical Fundamentals of Numerical Mechanics	4 CR	Schnack
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-110375	Mathematical Methods in Continuum Mechanics	4 CR	Böhlke
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105295	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel

T-MACH-105419	Mathematical Models and Methods in Combustion Theory	4 CR	Bykov, Maas
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MACH-108717	Mechanics of Laminated Composites	4 CR	Schnack
T-MACH-105333	Mechanics and Strength of Polymers	4 CR	von Bernstorff
T-MACH-105334	Mechanics in Microtechnology	4 CR	Greiner, Gruber
T-MACH-105335	Measurement II	4 CR	Stiller
T-MACH-105468	Metals	6 CR	Heilmaier, Pundt
T-MACH-105167	Analysis Tools for Combustion Diagnostics	4 CR	Pfeil
T-MACH-105557	Microenergy Technologies	4 CR	Kohl
T-MACH-101910	Microactuators	4 CR	Kohl
T-MACH-105303	Modelling of Microstructures	5 CR	August, Nestler
T-MACH-102199	Model Based Application Methods	4 CR	Kirschbaum
T-MACH-105396	Modeling of Thermodynamical Processes	6 CR	Maas, Schießl
T-MACH-100300	Modelling and Simulation	5 CR	Gumbsch, Nestler
T-MACH-105169	Engine Measurement Techniques	4 CR	Bernhardt
T-MACH-105180	Nanotechnology for Engineers and Natural Scientists	4 CR	Dienwiebel, Hölscher, Walheim
T-MACH-102167	Nanotribology and -Mechanics	4 CR	Dienwiebel, Hölscher
T-MACH-106747	Neurovascular Interventions (BioMEMS V)	4 CR	Cattaneo, Guber
T-MACH-105435	Neutron Physics of Fusion Reactors	4 CR	Fischer
T-MACH-110380	Nonlinear optimization methods	6 CR	Schneider
T-MACH-105532	Nonlinear Continuum Mechanics	5 CR	Böhlke
T-MACH-108720	Numerical Mechanics for Industrial Applications	4 CR	Schnack
T-MACH-105420	Numerical Simulation of Multi-Phase Flows	4 CR	Wörner
T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	4 CR	Koch
T-MACH-105397	Numerical Simulation of Turbulent Flows	4 CR	Grötzbach
T-MACH-105338	Numerical Fluid Mechanics	4 CR	Magagnato
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-100530	Physics for Engineers	5 CR	Dienwiebel, Gumbsch, Nesterov-Müller, Weygand
T-MACH-102102	Physical Basics of Laser Technology	5 CR	Schneider
T-MACH-105387	Planning of Assembly Systems	4 CR	Haller
T-MACH-105516	Multi-Scale Plasticity	4 CR	Greiner, Schulz
T-MACH-102181	PLM for Product Development in Mechatronics	4 CR	Eigner
T-MACH-105340	PLM in the Manufacturing Industry	4 CR	Ovtcharova
T-MACH-102137	Polymer Engineering I	4 CR	Elsner
T-MACH-102138	Polymer Engineering II	4 CR	Elsner
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-105470	Production Planning and Control	4 CR	Rinn
T-MACH-105523	Productivity Management in Production Systems	4 CR	Stowasser
T-MACH-102156	Project Workshop: Automotive Engineering	6 CR	Frey, Gauterin, Gießler
T-MACH-105457	Project Mikromanufacturing: Development and Manufacturing of Microsystems	5 CR	Schulze
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Ays, Geerling
T-MACH-104599	Project Management in Rail Industry	4 CR	Gratzfeld

T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-MACH-105348	Process Simulation in Forming Operations	4 CR	Helm
T-MACH-102157	High Performance Powder Metallurgy Materials	4 CR	Schell
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-105405	Reactor Safety I: Fundamentals	4 CR	Sanchez-Espinoza
T-MACH-105350	Computational Vehicle Dynamics	4 CR	Proppe
T-MACH-105384	Computerized Multibody Dynamics	4 CR	Seemann
T-MACH-105351	Computational Mechanics I	6 CR	Böhlke, Langhoff
T-MACH-105352	Computational Mechanics II	6 CR	Böhlke, Langhoff
T-MACH-105421	Reduction Methods for the Modeling and the Simulation of Vombustion Processes	4 CR	Bykov, Maas
T-MACH-109122	X-ray Optics	4 CR	Last
T-MACH-105724	Failure Analysis	4 CR	Greiner, Schneider
T-MACH-105353	Rail Vehicle Technology	4 CR	Gratzfeld
T-MACH-105354	Fatigue of Metallic Materials	4 CR	Guth, Lang
T-MACH-105171	Safety Engineering	4 CR	Kany
T-MACH-105971	Simulation of the process chain of continuously fiber reinforced composite structure	4 CR	Kärger
T-MACH-105172	Simulation of Coupled Systems	4 CR	Geimer, Xiang
T-MACH-105400	Scaling in Fluid Dynamics	4 CR	Bühler
T-MACH-106493	Solar Thermal Energy Systems	4 CR	Dagan
T-MACH-105372	Theory of Stability	6 CR	Fidlin
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-105696	Strategic product development - identification of potentials of innovative products	3 CR	Albers, Matthiesen, Siebe
T-MACH-105422	Flows with Chemical Reactions	4 CR	Class
T-MACH-105403	Flows and Heat Transfer in Energy Technology	4 CR	Cheng
T-MACH-102170	Structural and Phase Analysis	4 CR	Wagner
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger
T-MACH-102179	Structural Ceramics	4 CR	Hoffmann
T-MACH-102103	Superhard Thin Film Materials	4 CR	Ulrich
T-MACH-105181	Supply Chain Management	6 CR	Alicke
T-MACH-105358	Sustainable Product Engineering	4 CR	Albers, Matthiesen, Ziegahn
T-MACH-105360	Computer Engineering	6 CR	Keller, Lorch
T-MACH-102083	Integrated Information Systems for Engineers	4 CR	Ovtcharova
T-MACH-105361	Technical Design in Product Development	4 CR	Albers, Matthiesen, Schmid
T-MACH-105362	Technology of Steel Components	4 CR	Schulze
T-MACH-105456	Ten Lectures on Turbulence	4 CR	Otic
T-MACH-105225	Thermal Solar Energy	4 CR	Stieglitz
T-MACH-105363	Thermal Turbomachines I	6 CR	Bauer
T-MACH-105364	Thermal Turbomachines II	6 CR	Bauer
T-MACH-107670	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	4 CR	Franke, Seifert
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-105423	Tractors	4 CR	Becker, Geimer, Kremmer
T-MACH-105365	Turbine and Compressor Design	4 CR	Bauer
T-MACH-105366	Turbo Jet Engines	4 CR	Bauer
T-MACH-105177	Metal Forming	4 CR	Herlan
T-MACH-105429	Combustion Diagnositics	4 CR	Maas, Schießl

T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
T-MACH-102139	Failure of Structural Materials: Fatigue and Creep	4 CR	Gruber, Gumbsch
T-MACH-102140	Failure of Structural Materials: Deformation and Fracture	4 CR	Gumbsch, Weygand
T-MACH-102148	Gear Cutting Technology	4 CR	Klaiber
T-MACH-102123	Virtual Engineering I	4 CR	Ovtcharova
T-MACH-102124	Virtual Engineering II	4 CR	Ovtcharova
T-MACH-105430	Heatpumps	4 CR	Maas, Wirbser
T-MACH-105529	Heat Transfer in Nuclear Reactors	4 CR	Cheng
T-MACH-105416	Hydrogen Technologies	4 CR	Jordan
T-MACH-105443	Wave Propagation	4 CR	Seemann
T-MACH-105211	Materials of Lightweight Construction	4 CR	Liebig
T-MACH-105369	Materials Modelling: Dislocation Based Plasticy	4 CR	Weygand
T-MACH-100532	Scientific Computing for Engineers	5 CR	Gumbsch, Weygand
T-MACH-105985	Ignition systems	4 CR	Toedter
T-MACH-105406	Two-Phase Flow and Heat Transfer	4 CR	Schulenberg, Wörner
T-MACH-105652	Fundamentals of Combustion Engine Technology	5 CR	Bernhardt, Kubach, Pfeil, Toedter, Wagner
T-MACH-110318	Product- and Production-Concepts for modern Automobiles	4 CR	Kienzle, Steegmüller
T-MACH-110334	International Production Engineering A	4 CR	Fleischer
T-MACH-110335	International Production Engineering B	4 CR	Fleischer
T-MACH-110396	Strategic product development - identification of potentials of innovative products - Case Study	1 CR	Albers, Matthiesen, Siebe
T-MACH-110431	Digital microstructure characterization and modeling	6 CR	Schneider
Election block: Wahlpflichtmodul Maschinenbau (Ü) ()			
T-MACH-108887	Design and Development of Mobile Machines - Advance	0 CR	Geimer, Siebert
T-MACH-108889	BUS-Controls - Advance	0 CR	Daiß, Geimer
T-MACH-108888	Simulation of Coupled Systems - Advance	0 CR	Geimer, Xiang
T-MACH-109304	Excercises - Fatigue of Welded Components and Structures	1 CR	Farajian, Gumbsch
T-MACH-107671	Exercises for Applied Materials Simulation	2 CR	Gumbsch, Schulz
T-MACH-107632	Exercises for Solid State Reactions and Kinetics of Phase Transformations	2 CR	Franke, Seifert
T-MACH-110333	Tutorial Continuum Mechanics of solids and fluids	1 CR	Böhlke, Frohnapfel
T-MACH-110376	Tutorial Mathematical Methods in Continuum Mechanics	1 CR	Böhlke
T-MACH-107669	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	2 CR	Seifert

Competence Certificate
written or oral exam

Competence Goal
The elective course serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

Prerequisites
none

Content
see chosen brick courses.

Workload
The work load is about 240 hours, corresponding to 8 credit points. The work load varies from lecture to lecture, for example a lecture consisting of 4 credit points includes 28 h of presence during the lecture and 92 h preparation and rework time at home, 120 hours in total.

Learning type
Lecture, Tutorial, Lab Course

10.2 Module: Compulsory Elective Module Natural Science/Computer Science/ Electrical Engineering (MSc-Modul WPF-Modul NIE) [M-MACH-102595]

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

Part of: Advanced Engineering Fundamentals

Credits	Recurrence	Level	Version
6	Once	4	1

Election block: Wahlpflichtmodul Naturwissenschaften/Informatik/Elektrotechnik (1 item)			
T-MACH-108847	Applied Mathematics in Natural Science: Flows with chemical reactions	6 CR	Class
T-MACH-108845	Magnetohydrodynamics	6 CR	Bühler
T-ETIT-100694	Methods of Signal Processing	6 CR	Puente León
T-ETIT-101939	Photovoltaics	6 CR	Powalla
T-MACH-109084	Physical Basics of Laser Technology	6 CR	Schneider
T-ETIT-109313	Signals and Systems	6 CR	Puente León
T-MACH-108846	Stability: from order to chaos	6 CR	Class
T-MACH-105360	Computer Engineering	6 CR	Keller, Lorch

Competence Certificate
The success is monitored within the framework of academic achievements, it can vary according to the individually choice. The module is not graded, and remains not graded even after the choice of one or several graded brick courses.

Competence Goal
After completing the elective module "Wahlpflichtmodul" the attendants are able to extend their knowledge in the field of mechanical engineering in the disciplines natural sciences, electrical engineering or the informatics. The attendants are aware of example approaches and know specific methods and fundamentals of these fields. Thus, the attendants are able to solve interdisciplinary problems by applying this knowledge and to adopt specialist skills by themselves later.

Prerequisites
none

Content
Please refer to the description of the listed courses.

Workload
The work load is about 180 hours, corresponding to 6 credit points.

Learning type
Lecture
Exercise course (depending on the course)

M 10.3 Module: Compulsory Elective Subject Economics/Law (MSc-Modul WPF-Modul WR) [M-MACH-102596]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: Advanced Engineering Fundamentals

Credits	Recurrence	Language	Level	Version
4	Once	German	4	1

Election block: Wahlpflichtmodul Wirtschaft/Recht (1 item)			
T-MACH-105519	Human Factors Engineering II	4 CR	Deml
T-MACH-105231	Leadership and Management Development	4 CR	Albers, Matthiesen, Ploch
T-MACH-105440	Leadership and Conflict Management	4 CR	Hatzl
T-MACH-102107	Quality Management	4 CR	Lanza
T-INFO-101310	Patent Law	4 CR	Dreier
T-INFO-101963	Public Law I - Basic Principles	4 CR	Marsch

Competence Certificate
The success is monitored within the framework of academic achievements, it can vary according to the individually choice. The module is not graded, and remains not graded even after the choice of one or several graded brick courses.

Competence Goal
Students can enlarge their knowledge about law and economics which affect mechanical engineering self-determined. They are able to describe circumstances of the case considering law or economics and apply it to simple cases. Later on in work life, they are able to evaluate, if and which subject specific support is necessary.

Prerequisites
none

Content
see chosen subject

Workload
The work load is about 120 hours, corresponding to 4 credit points.

Learning type
Lectures and practices; self-study

10.4 Module: Fundamentals and Methods of Automotive Engineering (MSc-WPfM-GuM-FzgT) [M-MACH-102739]

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

Part of: Specialization / Specialization: Vehicle Technology (mandatory)

Credits	Language	Level	Version
8	German/English	4	1

Election block: Grundlagen und Methoden der Fahrzeugtechnik (2 items)			
T-MACH-105518	Human Factors Engineering I	4 CR	Deml
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-ETIT-100534	Electrical Engineering for Business Engineers, Part II	5 CR	Menesklou
T-MACH-102093	Fluid Power Systems	4 CR	Geimer, Pult
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas, Sommerer
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-100297	Mathematical Methods in Strength of Materials	5 CR	Böhlke
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105295	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel
T-MACH-100300	Modelling and Simulation	5 CR	Gumbsch, Nestler
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MATH-102242	Numerical Mathematics for Students of Computer Science	6 CR	Rieder, Weiß, Wieners
T-MACH-102102	Physical Basics of Laser Technology	5 CR	Schneider
T-MACH-100530	Physics for Engineers	5 CR	Dienwiebel, Gumbsch, Nesterov-Müller, Weygand
T-MACH-105147	Product Lifecycle Management	4 CR	Ovtcharova
T-MACH-100531	Systematic Materials Selection	4 CR	Dietrich
T-MACH-105652	Fundamentals of Combustion Engine Technology	5 CR	Bernhardt, Kubach, Pfeil, Toedter, Wagner
T-MACH-102083	Integrated Information Systems for Engineers	4 CR	Ovtcharova
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MATH-109620	Probability Theory and Statistics	6 CR	Hug
T-MACH-105292	Heat and Mass Transfer	4 CR	Bockhorn, Maas
T-MACH-100532	Scientific Computing for Engineers	5 CR	Gumbsch, Weygand
Election block: Grundlagen und Methoden der Fahrzeugtechnik (Ü) ()			
T-MACH-106830	Tutorial Mathematical Methods in Strength of Materials	1 CR	Böhlke

Competence Certificate
2 individual exams: written or oral, graded

Competence Goal
"Fundamentals and Methods of Automotive Engineering" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

Prerequisites
None

Content
see chosen course

Workload
The work load is about 240 hours, corresponding to 8 credit points.

Learning type
Lecture, exercise.

M 10.5 Module: Fundamentals and Methods of Energy and Environmental Engineering (MSc-WPfM-GuM-E+U) [M-MACH-102575]

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

Part of: Specialization / Specialization: Energy- and Environment Engineering (mandatory)

Credits	Recurrence	Duration	Language	Level	Version
8	Once	1 term	German/English	4	1

Mandatory			
T-MACH-105292	Heat and Mass Transfer	4 CR	Bockhorn, Maas
Election block: Grundlagen und Methoden der Energie- und Umwelttechnik (1 item)			
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-102093	Fluid Power Systems	4 CR	Geimer, Pult
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas, Sommerer
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105295	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MATH-102242	Numerical Mathematics for Students of Computer Science	6 CR	Rieder, Weiß, Wieners
T-MACH-100530	Physics for Engineers	5 CR	Dienwiebel, Gumbsch, Nesterov-Müller, Weygand
T-MACH-102102	Physical Basics of Laser Technology	5 CR	Schneider
T-MACH-100531	Systematic Materials Selection	4 CR	Dietrich
T-MACH-105652	Fundamentals of Combustion Engine Technology	5 CR	Bernhardt, Kubach, Pfeil, Toedter, Wagner
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann

Competence Certificate
2 individual exams: written or oral, graded

Competence Goal
"Fundamentals and Methods of Energy and Environmental Engineering" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

Module grade calculation
weight according to CP

Prerequisites
none

Content
see chosen course

Workload
The work load is about 240 hours, corresponding to 8 credit points.

Learning type
Lecture, exercise

M 10.6 Module: Fundamentals and Methods of General Mechanical Engineering (MSc-WPfM-GuM-MB) [M-MACH-102405]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (mandatory)

Credits	Language	Level	Version
8	German/English	4	1

Election block: Grundlagen und Methoden des Maschinenbaus (2 items)			
T-MACH-105518	Human Factors Engineering I	4 CR	Deml
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-102093	Fluid Power Systems	4 CR	Geimer, Pult
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas, Sommerer
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-100297	Mathematical Methods in Strength of Materials	5 CR	Böhlke
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105295	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel
T-MACH-105298	Mathematical Methods in Structural Mechanics	5 CR	Böhlke
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MACH-105303	Modelling of Microstructures	5 CR	August, Nestler
T-MACH-100300	Modelling and Simulation	5 CR	Gumbsch, Nestler
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MACH-102102	Physical Basics of Laser Technology	5 CR	Schneider
T-MACH-100530	Physics for Engineers	5 CR	Dienwiebel, Gumbsch, Nesterov-Müller, Weygand
T-MACH-105147	Product Lifecycle Management	4 CR	Ovtcharova
T-MACH-100531	Systematic Materials Selection	4 CR	Dietrich
T-MACH-105652	Fundamentals of Combustion Engine Technology	5 CR	Bernhardt, Kubach, Pfeil, Toedter, Wagner
T-MACH-102083	Integrated Information Systems for Engineers	4 CR	Ovtcharova
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MACH-105292	Heat and Mass Transfer	4 CR	Bockhorn, Maas
T-MACH-100532	Scientific Computing for Engineers	5 CR	Gumbsch, Weygand
Election block: Grundlagen und Methoden des Maschinenbaus (Ü) ()			
T-MACH-106830	Tutorial Mathematical Methods in Strength of Materials	1 CR	Böhlke
T-MACH-106831	Tutorial Mathematical Methods in Structural Mechanics	1 CR	Böhlke

Competence Certificate
2 individual exams: written or oral, graded

Competence Goal
"Fundamentals and Methods of General Mechanical Engineering" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

Prerequisites
None.

Content
see chosen course

Workload
The work load is about 240 hours, corresponding to 8 credit points.

Learning type
Lecture, exercise

10.7 Module: Fundamentals and Methods of Materials and Structures for High Performance Systems (MSc-WPfPM-W+S) [M-MACH-102744]

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

Part of: Specialization / Specialization: Materials and Structures for High Performance Systems (mandatory)

Credits	Language	Level	Version
8	German/English	4	2

Mandatory			
T-MACH-100531	Systematic Materials Selection	4 CR	Dietrich
Election block: Grundlagen und Methoden der Werkstoffe und Strukturen für Hochleistungssysteme (1 item)			
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105303	Modelling of Microstructures	5 CR	August, Nestler
T-MACH-100300	Modelling and Simulation	5 CR	Gumbsch, Nestler
T-MACH-100530	Physics for Engineers	5 CR	Dienwiebel, Gumbsch, Nesterov-Müller, Weygand
T-MACH-102102	Physical Basics of Laser Technology	5 CR	Schneider
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MACH-100532	Scientific Computing for Engineers	5 CR	Gumbsch, Weygand
T-MACH-110375	Mathematical Methods in Continuum Mechanics	4 CR	Böhlke
T-MACH-110378	Mathematical Methods in Micromechanics	5 CR	Böhlke
Election block: Grundlagen und Methoden der Werkstoffe und Strukturen für Hochleistungssysteme (Ü) ()			
T-MACH-110379	Tutorial Mathematical Methods in Micromechanics	1 CR	Böhlke
T-MACH-110376	Tutorial Mathematical Methods in Continuum Mechanics	1 CR	Böhlke

Competence Certificate
2 individual exams: written or oral, graded

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

Content
see chosen course

Workload
The work load is about 240 hours, corresponding to 8 credit points.

Learning type
Lecture, exercise.

M 10.8 Module: Fundamentals and Methods of Mechatronics and Microsystem Technology (MSc-WPfM-M+M) [M-MACH-102740]

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

Part of: Specialization / Specialization: Mechatronics and Microsystems Technology (mandatory)

Credits	Language	Level	Version
8	German/English	4	1

Election block: Grundlagen und Methoden der Mechatronik und Mikrosystemtechnik, Pflicht (1 item)			
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
Election block: Grundlagen und Methoden der Mechatronik und Mikrosystemtechnik (1 item)			
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas, Sommerer
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-100297	Mathematical Methods in Strength of Materials	5 CR	Böhlke
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105298	Mathematical Methods in Structural Mechanics	5 CR	Böhlke
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MATH-102242	Numerical Mathematics for Students of Computer Science	6 CR	Rieder, Weiß, Wieners
T-MACH-102102	Physical Basics of Laser Technology	5 CR	Schneider
T-MACH-100530	Physics for Engineers	5 CR	Dienwiebel, Gumbsch, Nesterov-Müller, Weygand
T-MACH-105147	Product Lifecycle Management	4 CR	Ovtcharova
T-MACH-100531	Systematic Materials Selection	4 CR	Dietrich
T-MACH-105652	Fundamentals of Combustion Engine Technology	5 CR	Bernhardt, Kubach, Pfeil, Toedter, Wagner
T-MACH-102083	Integrated Information Systems for Engineers	4 CR	Ovtcharova
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MATH-109620	Probability Theory and Statistics	6 CR	Hug
T-MACH-105292	Heat and Mass Transfer	4 CR	Bockhorn, Maas
Election block: Grundlagen und Methoden der Mechatronik und Mikrosystemtechnik (Ü) ()			
T-MACH-106830	Tutorial Mathematical Methods in Strength of Materials	1 CR	Böhlke
T-MACH-106831	Tutorial Mathematical Methods in Structural Mechanics	1 CR	Böhlke

Competence Certificate
2 individual exams: written or oral, graded

Competence Goal
"Fundamentals and Methods of Mechatronics and Microsystem Technology" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

Prerequisites
None

Content
see chosen course

Workload
The work load is about 240 hours, corresponding to 8 credit points.

Learning type
Lecture, exercise

M 10.9 Module: Fundamentals and Methods of Product Development and Construction (MSc-WPfM-GuM-PEK) [M-MACH-102741]

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

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: Product Development and Engineering Design (mandatory)

Credits	Language	Level	Version
8	German/English	4	1

Election block: Grundlagen und Methoden der Produktentwicklung und Konstruktion (2 items)			
T-MACH-105518	Human Factors Engineering I	4 CR	Deml
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-102093	Fluid Power Systems	4 CR	Geimer, Pult
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-100297	Mathematical Methods in Strength of Materials	5 CR	Böhlke
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105295	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel
T-MACH-105298	Mathematical Methods in Structural Mechanics	5 CR	Böhlke
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MACH-102102	Physical Basics of Laser Technology	5 CR	Schneider
T-MACH-105147	Product Lifecycle Management	4 CR	Ovtcharova
T-MACH-100531	Systematic Materials Selection	4 CR	Dietrich
T-MACH-105652	Fundamentals of Combustion Engine Technology	5 CR	Bernhardt, Kubach, Pfeil, Toedter, Wagner
T-MACH-102083	Integrated Information Systems for Engineers	4 CR	Ovtcharova
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MACH-105292	Heat and Mass Transfer	4 CR	Bockhorn, Maas
Election block: Grundlagen und Methoden der Produktentwicklung und Konstruktion (Ü) ()			
T-MACH-106830	Tutorial Mathematical Methods in Strength of Materials	1 CR	Böhlke
T-MACH-106831	Tutorial Mathematical Methods in Structural Mechanics	1 CR	Böhlke

Competence Certificate
2 individual exams: written or oral, graded

Competence Goal
"Fundamentals and Methods of Product Development and Construction" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical Engineering.

Prerequisites
None

Content
See courses.

Workload
The work load is about 240 hours, corresponding to 8 credit points.

Learning type
Lecture, exercise.

10.10 Module: Fundamentals and Methods of Production Technology (MSc-WPf-GuM-PT) [M-MACH-102742]

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

Part of: Specialization / Specialization: Production Technology (mandatory)

Credits	Language	Level	Version
8	German/English	4	1

Election block: Grundlagen und Methoden der Produktionstechnik (2 items)			
T-MACH-105518	Human Factors Engineering I	4 CR	Deml
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-102093	Fluid Power Systems	4 CR	Geimer, Pult
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-100297	Mathematical Methods in Strength of Materials	5 CR	Böhlke
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MACH-100300	Modelling and Simulation	5 CR	Gumbsch, Nestler
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MATH-102242	Numerical Mathematics for Students of Computer Science	6 CR	Rieder, Weiß, Wieners
T-MACH-102102	Physical Basics of Laser Technology	5 CR	Schneider
T-MACH-105147	Product Lifecycle Management	4 CR	Ovtcharova
T-MACH-100531	Systematic Materials Selection	4 CR	Dietrich
T-MACH-102083	Integrated Information Systems for Engineers	4 CR	Ovtcharova
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
Election block: Grundlagen und Methoden der Produktionstechnik (Ü) ()			
T-MACH-106830	Tutorial Mathematical Methods in Strength of Materials	1 CR	Böhlke

Competence Certificate
2 exams:

Oral exams: duration approx. 5 min per credit point

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

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

Competence Goal
"Fundamentals and Methods of Production Technology" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering

Prerequisites
none

Content
Fundamentals and Methods of Production Technology

Workload
The work load is about 240 hours, corresponding to 8 credit points.

Learning type
Lectures, seminars, workshops, excursions

10.11 Module: Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering (MSc-WPfM-GuM-ThM) [M-MACH-102743]

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

Part of: Specialization / Specialization: Theoretical Mechanical Engineering (mandatory)

Credits	Language	Level	Version
8	German/English	4	2

Election block: Grundlagen und Methoden des Theoretischen Maschinenbaus (2 items)			
T-MACH-109302	Computational Homogenization on Digital Image Data	6 CR	Schneider
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-102093	Fluid Power Systems	4 CR	Geimer, Pult
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas, Sommerer
T-MACH-110377	Advanced Methods in Strength of Materials	4 CR	Böhlke, Frohnapfel
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-110375	Mathematical Methods in Continuum Mechanics	4 CR	Böhlke
T-MACH-110378	Mathematical Methods in Micromechanics	5 CR	Böhlke
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105295	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MACH-105303	Modelling of Microstructures	5 CR	August, Nestler
T-MACH-100300	Modelling and Simulation	5 CR	Gumbsch, Nestler
T-MACH-110380	Nonlinear optimization methods	6 CR	Schneider
T-MATH-102242	Numerical Mathematics for Students of Computer Science	6 CR	Rieder, Weiß, Wieners
T-MACH-100530	Physics for Engineers	5 CR	Dienwiebel, Gumbsch, Nesterov-Müller, Weygand
T-MACH-100531	Systematic Materials Selection	4 CR	Dietrich
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MATH-109620	Probability Theory and Statistics	6 CR	Hug
T-MACH-105292	Heat and Mass Transfer	4 CR	Bockhorn, Maas
T-MACH-100532	Scientific Computing for Engineers	5 CR	Gumbsch, Weygand
Election block: Grundlagen und Methoden des Theoretischen Maschinenbaus (Ü) ()			
T-MACH-110333	Tutorial Continuum Mechanics of solids and fluids	1 CR	Böhlke, Frohnapfel
T-MACH-110376	Tutorial Mathematical Methods in Continuum Mechanics	1 CR	Böhlke
T-MACH-110379	Tutorial Mathematical Methods in Micromechanics	1 CR	Böhlke

Competence Certificate
2 individual exams: written or oral, graded

Competence Goal
"Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering" serves as a comprehensive, in-depth analysis of fundamentals in selected areas of mechanical engineering.

Prerequisites
None

Content
see chosen course

Workload
The work load is about 240 hours, corresponding to 8 credit points.

Learning type
Lecture, tutorial

10.12 Module: Key Competences [M-MACH-102824]

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

Part of: Advanced Engineering Fundamentals

Credits	Recurrence	Duration	Level	Version
2	Once	2 term	4	2

Election block: Schlüssselqualifikationen (1 item)			
T-MACH-105721	Engineer's Field of Work	2 CR	Doppelbauer, Gratzfeld
T-MACH-106375	Value stream within enterprises – The value chain at Bosch	2 CR	Maier
T-MACH-106700	Do it! – Service-Learning for prospective mechanical engineers	2 CR	Deml
T-MACH-106377	HoC lectures	2 CR	Heilmaier
T-MACH-106376	ZAK lectures	2 CR	Heilmaier

Competence Certificate
Success is monitored within the framework of academic achievements.

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

Competence Goal
After completing the module Key Competences students can

- determine and coordinate work steps, projects and goals, proceed systematically and purposefully, set priorities as well as assess the feasibility of a task,
- apply methods for the planning of a specific task under given framework conditions in a goal- and resource-oriented way,
- describe methods for scientific research and selection of technical information according to pre-established quality criteria and apply them to given problems,
- discuss empirical methods and apply them to selected examples,
- present technical information in a clear, readable, and convincingly argued manner in various forms of presentation (e.g. poster, exposé, abstract) in writing and appropriately visualize it graphically (e.g. engineering drawings, flowcharts),
- present and stand up for technical content in a convincing and appealing way,
- work as a team in a task-oriented manner, handle any conflicts on their own and take responsibility for themselves and others,
- communicate as a team in an objective, goal-oriented and interpersonal manner, represent their own interests, reflect and take into account the interests of others in their own words, and successfully organize the course of the conversation.

Module grade calculation
Certification without note

Prerequisites
none

Content
The module Key Competences consists of freely selectable courses offered by the KIT-House of Competence (HoC), the KIT Language Centre (SPZ) and the Centre for Cultural and General Studies (ZAK) with a work load corresponding to a total of at least 2 ECTS. Upon request, the examination board may approve further courses as freely selectable subjects in the module "Key Competences".

Annotation
Only HoC/SPZ/ZAK courses can be chosen.

Workload
The work load is about 60 hours, corresponding to 2 credit points in the Master of Science program.

Learning type

The teaching and learning methods depend on the respectively chosen courses. The courses can be lectures, seminars, tutorials, or lab courses.

M 10.13 Module: Laboratory Course (MSc-Modul 07, FP) [M-MACH-102591]

Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: Advanced Engineering Fundamentals

Credits	Recurrence	Language	Level	Version
4	Once	German/English	4	2

Election block: Laborpraktikum (1 item)			
T-MACH-105230	Decentrally Controlled Intralogistic Systems	4 CR	Furmans, Hochstein
T-MACH-105447	Metallographic Lab Class	4 CR	Hauf
T-MACH-105222	Motor Vehicle Labor	4 CR	Frey
T-MACH-108312	Introduction to Microsystem Technology - Practical Course	4 CR	Last
T-MACH-105331	Laboratory Exercise in Energy Technology	4 CR	Bauer, Maas, Wirbser
T-MACH-105370	Laboratory Mechatronics	4 CR	Lorch, Seemann, Stiller
T-MACH-105300	Measurement Instrumentation Lab	4 CR	Spindler, Stiller
T-MACH-105337	Engine Laboratory	4 CR	Wagner
T-MACH-106693	Plug-and-play material handling	4 CR	Dziedzitz, Furmans
T-MACH-106707	Workshop on computer-based flow measurement techniques	4 CR	Bauer
T-MACH-102154	Laboratory Laser Materials Processing	4 CR	Schneider
T-MACH-105343	Lab Course Experimental Solid Mechanics	4 CR	Böhlke
T-MACH-108878	Laboratory Production Metrology	4 CR	Häfner
T-MACH-105813	Practical Course "Tribology"	4 CR	Dienwiebel, Schneider
T-MACH-105346	Production Techniques Laboratory	4 CR	Deml, Fleischer, Furmans, Ovtcharova
T-MACH-106738	ProVIL - Product development in a Virtual Idea Laboratory	4 CR	Albers, Matthiesen
T-MACH-105373	Practical Training in Measurement of Vibrations	4 CR	Fidlin
T-MACH-108796	Flow Measurement Techniques	4 CR	Kriegseis

Competence Certificate
The success is monitored within the framework of academic achievements, it can vary according to the individually choice. The module is not graded, and remains not graded even after the choice of one or several graded brick courses.

Competence Goal
Students are able to:

- Model typical problems in the laboratory and use typical methods of mecanical science to inquire,
- Built experiment designs, while choosing appropriate system components and models,
- Accomplish experiments goal-oriented,
- Analyse and evaluate results of experiments.

Prerequisites
none

Content
see chosen practical training

Workload
The work load is about 120 hours, corresponding to 4 credit points.

Learning type
practical training, self-study

M 10.14 Module: Major Field: Advanced Materials Modelling (SP 56) [M-MACH-102649]

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

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)
Specialization / Specialization: Materials and Structures for High Performance Systems (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-105308	Atomistic Simulations and Molecular Dynamics	4 CR	Brandl, Gumbsch, Schneider
T-MACH-105532	Nonlinear Continuum Mechanics	5 CR	Böhlke
Election block: Advanced Materials Modelling (E) ()			
T-MACH-105459	High Temperature Materials	4 CR	Heilmaier
T-MACH-105554	Thin Film and Small-scale Mechanical Behavior	4 CR	Gruber, Schwaiger, Weygand

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

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

Competence Goal
The student can

- describe the physical foundation of particle based simulation method (e.g. molecular dynamics)

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.15 Module: Major Field: Advanced Mechatronics (SP 01) [M-MACH-102598]

Responsible: PD Dr.-Ing. Markus Reischl
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt (p))
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of each Major Field at least 8 ECTS have to be chosen.

Election block: Advanced Mechatronics (K) (at least 8 credits)			
T-MACH-105694	Data Analytics for Engineers	5 CR	Ludwig, Mikut, Reischl
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105335	Measurement II	4 CR	Stiller
T-MACH-105384	Computerized Multibody Dynamics	4 CR	Seemann
T-MACH-105443	Wave Propagation	4 CR	Seemann
Election block: Advanced Mechatronics (E) (at most 8 credits)			
T-MACH-105238	Actuators and Sensors in Nanotechnology	4 CR	Kohl
T-MACH-108844	Automated Manufacturing Systems	8 CR	Fleischer
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	Albers, Matthiesen
T-MACH-105314	Computational Intelligence	4 CR	Jakob, Mikut, Reischl
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-105514	Experimental Dynamics	5 CR	Fidlin
T-MACH-105156	Vehicle Mechatronics I	4 CR	Ammon
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-105328	Information Processing in Mechatronic Systems	4 CR	Kaufmann
T-MACH-105187	IT-Fundamentals of Logistics	3 CR	Thomas
T-MACH-105378	Cognitive Automobiles - Laboratory	6 CR	Kitt, Lauer, Stiller
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
T-MACH-105223	Machine Vision	8 CR	Lauer, Stiller
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105334	Mechanics in Microtechnology	4 CR	Greiner, Gruber
T-INFO-101266	Human-Machine-Interaction	6 CR	Beigl
T-MACH-105557	Microenergy Technologies	4 CR	Kohl

T-MACH-108809	Micro- and nanosystem integration for medical, fluidic and optical applications	4 CR	Gengenbach, Hagenmeyer, Koker, Sieber
T-MACH-101910	Microactuators	4 CR	Kohl
T-MACH-105539	Modern Control Concepts I	4 CR	Groell, Matthes
T-MACH-106691	Modern Control Concepts II	4 CR	Groell
T-MACH-106692	Modern Control Concepts III	4 CR	Groell
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-INFO-108014	Robotics I - Introduction to Robotics	6 CR	Asfour
T-ETIT-109313	Signals and Systems	6 CR	Puente León
T-MACH-105372	Theory of Stability	6 CR	Fidlin
T-MACH-105521	Theoretical Description of Mechatronic Systems	4 CR	Seemann
T-MACH-105555	System Integration in Micro- and Nanotechnology	4 CR	Gengenbach
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
T-MACH-105985	Ignition systems	4 CR	Toedter
Election block: Advanced Mechatronics (P) (at most 4 credits)			
T-MACH-105341	Lab Computer-Aided Methods for Measurement and Control	4 CR	Stiller
T-MACH-108878	Laboratory Production Metrology	4 CR	Häfner
Election block: Advanced Mechatronics (Ü) ()			
T-MACH-106830	Tutorial Mathematical Methods in Strength of Materials	1 CR	Böhlke
T-INFO-106257	Human-Machine-Interaction Pass	0 CR	Beigl

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Students of the major Advanced Mechatronics know the future-oriented procedures. They are able to creatively solve complex interdisciplinary questions, in particular by applying the latest computer-assisted mathematical methods.

Prerequisites
None

Content
The Advanced Mechatronics offers a broad, multidisciplinary body of knowledge. It qualifies graduates to solve essential mechatronic questions. In particular the following disciplines are covered by the major Advanced Mechatronics:

- Control theory
- measurement technology and signal processing,
- modelling and
- mathematical methods.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
The contents of this major field are taught in form of lectures, exercises and practical experiences.

M 10.16 Module: Major Field: Applied Mechanics (SP 30) [M-MACH-102646]

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

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt (p))
Specialization / Specialization: Materials and Structures for High Performance Systems (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Angewandte Mechanik (K) (at least 8 credits)			
T-MACH-105351	Computational Mechanics I	6 CR	Böhlke, Langhoff
T-MACH-105352	Computational Mechanics II	6 CR	Böhlke, Langhoff
Election block: Angewandte Mechanik (E) (at most 8 credits)			
T-MACH-109302	Computational Homogenization on Digital Image Data	6 CR	Schneider
T-MACH-105321	Introduction to Theory of Materials	4 CR	Kamlah
T-MACH-105439	Introduction to Nonlinear Vibrations	7 CR	Fidlin
T-MACH-105324	Foundations of Nonlinear Continuum Mechanics	4 CR	Kamlah
T-MACH-105303	Modelling of Microstructures	5 CR	August, Nestler
T-MACH-105532	Nonlinear Continuum Mechanics	5 CR	Böhlke
T-MATH-102242	Numerical Mathematics for Students of Computer Science	6 CR	Rieder, Weiß, Wieners
T-MACH-105348	Process Simulation in Forming Operations	4 CR	Helm
T-MACH-105349	Computational Dynamics	4 CR	Proppe
T-MACH-105350	Computational Vehicle Dynamics	4 CR	Proppe
T-MACH-105971	Simulation of the process chain of continuously fiber reinforced composite structure	4 CR	Kärger
T-MACH-105372	Theory of Stability	6 CR	Fidlin
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MACH-105369	Materials Modelling: Dislocation Based Plasticy	4 CR	Weygand
T-MACH-100532	Scientific Computing for Engineers	5 CR	Gumbsch, Weygand
T-MACH-110431	Digital microstructure characterization and modeling	6 CR	Schneider
T-MACH-109302	Computational Homogenization on Digital Image Data	6 CR	Schneider
T-MACH-110378	Mathematical Methods in Micromechanics	5 CR	Böhlke
T-MACH-110380	Nonlinear optimization methods	6 CR	Schneider
T-MACH-110379	Tutorial Mathematical Methods in Micromechanics	1 CR	Böhlke

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After having finished this major field the students can

- list important mathematical concepts that are applied in mechanics
- analyze, evaluate and assess models of mechanics according to their mathematical structure
- apply mathematical algorithms for solving special problems in mechanics
- select a mathematical description of a given problem in mechanics

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials, consultation hours

10.17 Module: Major Field: Automation Technology (SP 04) [M-MACH-102601]

Responsible: Prof. Dr. Ralf Mikut
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt (p))
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Automatisierungstechnik (K) (at least 8 credits)			
T-MACH-105217	Automation Systems	4 CR	Kaufmann
T-MACH-105314	Computational Intelligence	4 CR	Jakob, Mikut, Reischl
T-MACH-105694	Data Analytics for Engineers	5 CR	Ludwig, Mikut, Reischl
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105539	Modern Control Concepts I	4 CR	Groell, Matthes
Election block: Automatisierungstechnik (E) (at most 8 credits)			
T-MACH-108844	Automated Manufacturing Systems	8 CR	Fleischer
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-105156	Vehicle Mechatronics I	4 CR	Ammon
T-MACH-105223	Machine Vision	8 CR	Lauer, Stiller
T-MACH-105335	Measurement II	4 CR	Stiller
T-MACH-108809	Micro- and nanosystem integration for medical, fluidic and optical applications	4 CR	Gengenbach, Hagenmeyer, Koker, Sieber
T-MACH-106691	Modern Control Concepts II	4 CR	Groell
T-MACH-106692	Modern Control Concepts III	4 CR	Groell
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-105990	Simulation of Optical Systems	4 CR	Sieber
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-105555	System Integration in Micro- and Nanotechnology	4 CR	Gengenbach
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
T-MACH-105443	Wave Propagation	4 CR	Seemann
T-MACH-109055	Machine Tools and Industrial Handling	8 CR	Fleischer
Election block: Automatisierungstechnik (P) (at most 4 credits)			
T-MACH-105370	Laboratory Mechatronics	4 CR	Lorch, Seemann, Stiller
T-MACH-105341	Lab Computer-Aided Methods for Measurement and Control	4 CR	Stiller
T-MACH-108878	Laboratory Production Metrology	4 CR	Häfner
T-MACH-102149	Virtual Reality Practical Course	4 CR	Ovtcharova

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The Automation Engineering offers both theoretical foundations and practical knowledge in the field of automation. Students can select, apply and enhance existing methods. The main focus of the major is on

- Applied control engineering
- Automation
- Examples of field applications

Students of Automation Engineering are qualified to master complex challenges of the future. They are able to apply their profound knowledge and the future-oriented methods independent of a particular application field.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

10.18 Module: Major Field: Cognitive Technical Systems (SP 22) [M-MACH-102609]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Kognitive Technische Systeme (K) (at least 8 credits)			
T-MACH-105694	Data Analytics for Engineers	5 CR	Ludwig, Mikut, Reischl
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
Election block: Kognitive Technische Systeme (E) (at most 8 credits)			
T-MACH-105314	Computational Intelligence	4 CR	Jakob, Mikut, Reischl
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-102128	Information Systems and Supply Chain Management	3 CR	Kilger
T-INFO-101466	Information Processing in Sensor Networks	6 CR	Hanebeck
T-MACH-105378	Cognitive Automobiles - Laboratory	6 CR	Kitt, Lauer, Stiller
T-INFO-101356	Cognitive Systems	6 CR	Dillmann, Waibel
T-INFO-101377	Localization of Mobile Agents	6 CR	Hanebeck
T-MACH-105223	Machine Vision	8 CR	Lauer, Stiller
T-MACH-105335	Measurement II	4 CR	Stiller
T-MACH-105350	Computational Vehicle Dynamics	4 CR	Proppe
T-INFO-108014	Robotics I - Introduction to Robotics	6 CR	Asfour
T-INFO-101352	Robotics III - Sensors in Robotics	3 CR	Asfour
Election block: Kognitive Technische Systeme (P) (at most 4 credits)			
T-MACH-105370	Laboratory Mechatronics	4 CR	Lorch, Seemann, Stiller
T-MACH-105341	Lab Computer-Aided Methods for Measurement and Control	4 CR	Stiller

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Students are able to

- explain fundamental components and processing steps of cognitive technical systems
- explain the interplay of individual components and the flow of information between them
- outline the major properties of cognitive functions at examples in emerging applications like vehicular technology or robotics
- determine the level of system function and safety for cognitive technical systems

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.19 Module: Major Field: Combustion Engines Based Powertrains (SP 58) [M-MACH-102650]

Responsible: Prof. Dr. Thomas Koch
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt (p))
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Mandatory			
T-MACH-105564	Energy Conversion and Increased Efficiency in Internal Combustion Engines	4 CR	Koch, Kubach
T-MACH-102194	Combustion Engines I	4 CR	Koch, Kubach
Election block: Verbrennungsmotorische Antriebssysteme (K) ()			
T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment	4 CR	Deutschmann, Grunwaldt, Kubach, Lox
T-MACH-105167	Analysis Tools for Combustion Diagnostics	4 CR	Pfeil
T-MACH-105169	Engine Measurement Techniques	4 CR	Bernhardt
T-MACH-104609	Combustion Engines II	5 CR	Koch, Kubach
Election block: Verbrennungsmotorische Antriebssysteme (E) ()			
T-MACH-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines	4 CR	Gohl
T-MACH-105655	Alternative Powertrain for Automobiles	4 CR	Noreikat
T-MACH-105451	Drive Systems and Possibilities to Increase Efficiency	2 CR	Kollmeier
T-MACH-105649	Boosting of Combustion Engines	4 CR	Kech, Kubach
T-MACH-105310	Design of Highly Stresses Components	4 CR	Aktaa
T-MACH-102162	Automated Manufacturing Systems	9 CR	Fleischer
T-MACH-105184	Fuels and Lubricants for Combustion Engines	4 CR	Kehrwald, Kubach
T-MACH-105154	Vehicle Comfort and Acoustics I	4 CR	Gauterin
T-MACH-105155	Vehicle Comfort and Acoustics II	4 CR	Gauterin
T-MACH-105533	Gasdynamics	4 CR	Magagnato
T-MACH-100092	Automotive Engineering I	8 CR	Gauterin, Unrau
T-MACH-102117	Automotive Engineering II	4 CR	Gauterin, Unrau
T-MACH-105325	Fundamentals of Combustion II	4 CR	Maas
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-102199	Model Based Application Methods	4 CR	Kirschbaum
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-MACH-105358	Sustainable Product Engineering	4 CR	Albers, Matthiesen, Ziegahn
T-MACH-105531	Tribology	8 CR	Dienwiebel, Scherge
T-MACH-105985	Ignition systems	4 CR	Toedter
Election block: Verbrennungsmotorische Antriebssysteme (P) (at most 4 credits)			

T-MACH-105337	Engine Laboratory	4 CR	Wagner
Election block: Verbrennungsmotorische Antriebssysteme (Ü) ()			
T-MACH-109303	Exercices - Tribology	0 CR	Dienwiebel

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After completion of SP 48 students are able to:

- transfer fundamentals of thermodynamics and technical combustion to applications of combustion engines
- name and describe applications
- describe and explain the working principle of combustion engine and its application in vehicles
- analyze and evaluate propulsion systems

Prerequisites
None

Content
Energy converting machines are a key issue of technical engineering. Design and working principle are subject of the core area of SP 48. Fundamentals of thermodynamics are transferred to the application of internal combustion engines. In the supplementary area Measurement techniques to analyze and develop combustion engines as well as Fuels, Lubes and special engine concepts are addressed. The application of engines in drivetrains and production processes are continuative topics.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, tutorial.

M 10.20 Module: Major Field: Computational Mechanics (SP 06) [M-MACH-102604]

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

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt (p))

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Computational Mechanics (K) (at least 8 credits)			
T-MACH-105338	Numerical Fluid Mechanics	4 CR	Magagnato
T-MACH-105349	Computational Dynamics	4 CR	Proppe
T-MACH-105351	Computational Mechanics I	6 CR	Böhlke, Langhoff
Election block: Computational Mechanics (E) (at most 8 credits)			
T-MACH-105390	Application of Advanced Programming Languages in Mechanical Engineering	4 CR	Weygand
T-MACH-105308	Atomistic Simulations and Molecular Dynamics	4 CR	Brandl, Gumbsch, Schneider
T-MACH-105391	Finite Difference Methods for Numerial Solution of Thermal and Fluid Dynamical Problems	4 CR	Günther
T-MACH-105394	Finite Volume Methods for Fluid Flow	4 CR	Günther
T-MACH-105396	Modeling of Thermodynamical Processes	6 CR	Maas, Schießl
T-MACH-105420	Numerical Simulation of Multi-Phase Flows	4 CR	Wörner
T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	4 CR	Koch
T-MACH-105397	Numerical Simulation of Turbulent Flows	4 CR	Grötzbach
T-MACH-105350	Computational Vehicle Dynamics	4 CR	Proppe
T-MACH-105352	Computational Mechanics II	6 CR	Böhlke, Langhoff
Election block: Computational Mechanics (P) (at most 4 credits)			
T-MACH-105392	FEM Workshop - Constitutive Laws	4 CR	Schulz, Weygand

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The module offers a wide interdisciplinary education of the students in the areas which are summarized internationally under the concept 'Computational Mechanics':

* Continuum modelling (in structural mechanics, material theory, dynamics, fluid mechanics and thermodynamics)
* Numerical mathematics
* Informatics

Students know the procedures oriented to the future of modern engineering. They have the ability for individual, creative solutions of complicated problems with numerical means and take into account the interaction with neighboring fields.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

10.21 Module: Major Field: Development of Innovative Appliances and Power Tools (SP 51) [M-MACH-102642]

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

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt (p))
Specialization / Specialization: Production Technology (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election regulations
Elections in this module require confirmation. Election is only possible until the lower bounds are reached.

Mandatory			
T-MACH-105229	Appliance and Power Tool Design	8 CR	Albers, Matthiesen
Election block: Entwicklung innovativer Geräte (E) (at most 8 credits)			
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-105330	Design with Plastics	4 CR	Liedel
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
T-MACH-105231	Leadership and Management Development	4 CR	Albers, Matthiesen, Ploch
T-MACH-101910	Microactuators	4 CR	Kohl
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Ays, Geerling
T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-105696	Strategic product development - identification of potentials of innovative products	3 CR	Albers, Matthiesen, Siebe
T-MACH-110396	Strategic product development - identification of potentials of innovative products - Case Study	1 CR	Albers, Matthiesen, Siebe
Election block: Entwicklung innovativer Geräte (P) (at most 4 credits)			
T-MACH-105370	Laboratory Mechatronics	4 CR	Lorch, Seemann, Stiller

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Graduates are able to analyze and to synthesize complex technical products under consideration of customer, business and market demands. Specifically, they can address specific boundary conditions of devices and power tool manufacturers in power-tool development They and are able to take into account the resulting effects of complex product development projects: e.g. the production in large quantities, complexity of mechatronic solutions or workflow management of interdisciplinary and distributed development teams. The graduates are able to assess and optimize their work results in terms of quality, costs and user benefits. They have a holistic insight into the processes that are necessary for creating products in this specific context and thus are prepared for the technical and non-technical requirements of responsible positions in the team-oriented product development of devices and power tools.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, exercise.

10.22 Module: Major Field: Energy Converting Engines (SP 24) [M-MACH-102627]

Responsible: Prof. Dr. Thomas Koch
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Kraft- und Arbeitsmaschinen (K) (at least 8 credits)			
T-MACH-105326	Hydraulic Fluid Machinery	8 CR	Pritz
T-MACH-105363	Thermal Turbomachines I	6 CR	Bauer
T-MACH-102194	Combustion Engines I	4 CR	Koch, Kubach
Election block: Kraft- und Arbeitsmaschinen (E) (at most 8 credits)			
T-MACH-105649	Boosting of Combustion Engines	4 CR	Kech, Kubach
T-CIWVT-105780	Design of a jet engine combustion chamber	6 CR	Zarzalis
T-MACH-105184	Fuels and Lubricants for Combustion Engines	4 CR	Kehrwald, Kubach
T-MACH-105512	Experimental Fluid Mechanics	4 CR	Kriegseis
T-MACH-102093	Fluid Power Systems	4 CR	Geimer, Pult
T-MACH-105533	Gasdynamics	4 CR	Magagnato
T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment	4 CR	Deutschmann, Grunwaldt, Kubach, Lox
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas, Sommerer
T-MACH-105325	Fundamentals of Combustion II	4 CR	Maas
T-MACH-105338	Numerical Fluid Mechanics	4 CR	Magagnato
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Ays, Geerling
T-MACH-107447	Reliability Engineering 1	3 CR	Konnov
T-MACH-105364	Thermal Turbomachines II	6 CR	Bauer
T-MACH-105365	Turbine and Compressor Design	4 CR	Bauer
T-MACH-105366	Turbo Jet Engines	4 CR	Bauer
T-MACH-105234	Windpower	4 CR	Lewald
T-MACH-105784	Vortex Dynamics	4 CR	Kriegseis
T-MACH-105515	Introduction to Numerical Fluid Dynamics	4 CR	Pritz

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal

Die Studierenden erwerben in den grundlagenorientierten Kernfächern des Schwerpunktes breite und fundierte Kenntnisse der wissenschaftlichen Theorien, Prinzipien und Methoden der Kraft- und Arbeitsmaschinen, um diese entwerfen, einsetzen und bewerten zu können.

Darauf aufbauend vertiefen die Studierenden in den Ergänzungsfächern ausgewählte Anwendungsfelder, sodass sie im Anschluss in der Lage sind, Probleme aus diesem Anwendungsfeld selbstständig zu analysieren, zu bewerten und hierauf aufbauend Lösungsansätze zu entwickeln.

Die Studierenden können nach Abschluss des Schwerpunkts insbesondere

- Funktion und Einsatz von Kraft- und Arbeitsmaschinen benennen,
- den Stand der Technik und daraus resultierende Anwendungsfelder der Kraft- und Arbeitsmaschinen beschreiben und am Beispiel anzuwenden,
- grundlegende Theorien, Methoden und Eigenschaften für die verschiedenen Anwendungsfelder der Kraft- und Arbeitsmaschinen benennen und diese einsetzen und bewerten.

Prerequisites

None

Content

See brick courses.

Workload

The work load is about 480 hours, corresponding to 16 credit points.

Learning type

Lecture, tutorial.

M 10.23 Module: Major Field: Energy Technology for Buildings (SP 55) [M-MACH-102648]

Responsible: Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-105559	Technical Energy Systems for Buildings 1: Processes & Components	4 CR	Schmidt
Election block: Gebäudeenergietechnik (K) (at least 4 credits)			
T-MACH-105715	Energy demand of buildings – fundamentals and applications, with building simulation exercises	6 CR	Schmidt
T-MACH-105560	Technical Energy Systems for Buildings 2: System Concept	4 CR	Schmidt
Election block: Gebäudeenergietechnik (E) (at most 8 credits)			
T-MACH-105952	Energy Storage and Network Integration	4 CR	Jäger, Stieglitz
T-ARCH-107406	Energy and Indoor Climate Concepts	4 CR	Wagner
T-MACH-105408	Energy Systems I: Renewable Energy	6 CR	Dagan
T-ETIT-100724	Photovoltaic System Design	3 CR	Grab
T-MACH-105225	Thermal Solar Energy	4 CR	Stieglitz
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-105430	Heatpumps	4 CR	Maas, Wirbser
T-MACH-105234	Windpower	4 CR	Lewald

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After completing the courses in SP 55 „Energy technology for buildings“ the students have achieved a comprehensive overview on the energy demand for air-conditioning of buildings (heating, cooling, humidification, dehumidification, ventilation) and the techniques for energy supply of buildings (heat, cold, locally generated electricity). They know the methods for evaluation of technologies regarding ecologic, criteria, primary energy and economic viability and they have the ability to apply these methods to concrete cases. They also have gained knowledge on all renewable energy technologies that are relevant for application in buildings, in particular solar thermal collectors and systems and photovoltaic systems as well as energy storage technologies that are applied in buildings (heat storage, batteries).

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, exercise.

10.24 Module: Major Field: Engineering Design (SP 10) [M-MACH-102605]

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

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Entwicklung und Konstruktion (K) (at least 8 credits)			
T-MACH-105233	Powertrain Systems Technology A: Automotive Systems	4 CR	Albers, Matthiesen, Ott
T-MACH-105216	Powertrain Systems Technology B: Stationary Machinery	4 CR	Albers, Matthiesen, Ott
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
Election block: Entwicklung und Konstruktion (E) (at most 8 credits)			
T-MACH-105215	Applied Tribology in Industrial Product Development	4 CR	Albers, Lorentz, Matthiesen
T-MACH-105311	Design and Development of Mobile Machines	4 CR	Geimer, Siebert
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-108719	Designing with numerical methods in product development	4 CR	Schnack
T-MACH-108374	Vehicle Ergonomics	4 CR	Heine
T-MACH-102105	Manufacturing Technology	8 CR	Schulze, Zanger
T-MACH-100092	Automotive Engineering I	8 CR	Gauterin, Unrau
T-MACH-102116	Fundamentals for Design of Motor-Vehicle Bodies I	2 CR	Bardehle
T-MACH-102119	Fundamentals for Design of Motor-Vehicle Bodies II	2 CR	Bardehle
T-MACH-105160	Fundamentals in the Development of Commercial Vehicles I	2 CR	Zürn
T-MACH-105161	Fundamentals in the Development of Commercial Vehicles II	2 CR	Zürn
T-MACH-105162	Fundamentals of Automobile Development I	2 CR	Frech
T-MACH-105163	Fundamentals of Automobile Development II	2 CR	Frech
T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars	4 CR	Schlichtenmayer
T-MACH-105330	Design with Plastics	4 CR	Liedel
T-MACH-105231	Leadership and Management Development	4 CR	Albers, Matthiesen, Ploch
T-MACH-105440	Leadership and Conflict Management	4 CR	Hatzl
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Ays, Geerling
T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-105171	Safety Engineering	4 CR	Kany
T-MACH-105696	Strategic product development - identification of potentials of innovative products	3 CR	Albers, Matthiesen, Siebe

T-MACH-110396	Strategic product development - identification of potentials of innovative products - Case Study	1 CR	Albers, Matthiesen, Siebe
T-MACH-105358	Sustainable Product Engineering	4 CR	Albers, Matthiesen, Ziegahn
T-MACH-105361	Technical Design in Product Development	4 CR	Albers, Matthiesen, Schmid
T-MACH-109055	Machine Tools and Industrial Handling	8 CR	Fleischer
Election block: Entwicklung und Konstruktion (P) (at most 4 credits)			
T-MACH-105370	Laboratory Mechatronics	4 CR	Lorch, Seemann, Stiller
Election block: Entwicklung und Konstruktion (Ü) ()			
T-MACH-108887	Design and Development of Mobile Machines - Advance	0 CR	Geimer, Siebert

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students are able to transfer their knowledge und abilities in product engineering to mechanical systems in research and industrial practice.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

10.25 Module: Major Field: Engineering Thermodynamics (SP 45) [M-MACH-102635]

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

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)
Specialization / Specialization: Materials and Structures for High Performance Systems (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of each Major Field at least 8 ECTS have to be chosen.

Election block: Technische Thermodynamik (K) (at least 8 credits)			
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas, Sommerer
T-MACH-105325	Fundamentals of Combustion II	4 CR	Maas
T-MACH-105396	Modeling of Thermodynamical Processes	6 CR	Maas, Schießl
T-MACH-105403	Flows and Heat Transfer in Energy Technology	4 CR	Cheng
Election block: Technische Thermodynamik (E) (at most 8 credits)			
T-MACH-105428	Selected Chapters of the Combustion Fundamentals	4 CR	Maas
T-MACH-106373	Experimental techniques in thermo- and fluid-dynamics	4 CR	Cheng
T-MACH-105533	Gasdynamics	4 CR	Magagnato
T-MACH-105419	Mathematical Models and Methods in Combustion Theory	4 CR	Bykov, Maas
T-MACH-105167	Analysis Tools for Combustion Diagnostics	4 CR	Pfeil
T-MACH-105421	Reduction Methods for the Modeling and the Simulation of Vombustion Processes	4 CR	Bykov, Maas
T-MACH-105422	Flows with Chemical Reactions	4 CR	Class
T-MACH-105363	Thermal Turbomachines I	6 CR	Bauer
T-MACH-105364	Thermal Turbomachines II	6 CR	Bauer
T-MACH-105429	Combustion Diagnositics	4 CR	Maas, Schießl
T-MACH-102194	Combustion Engines I	4 CR	Koch, Kubach
T-MACH-105430	Heatpumps	4 CR	Maas, Wirbser

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After completion of SP 45 students are able to:

- apply the thermodynamic fundamentals of irreversible processes.
- explain the governing processes in combustion.
- outline the fundamentals of modeling and simulation of reacting flows.
- understand the working principle of technical systems applying thermodynamic processes and combustion.

Prerequisites
None

Content
Thermodynamics is considered to be the basis of all processes in nature and engineering. Combustion technology is still dominant as an energy conversion for power supply and for mobility applications. The major subject SP 45 extends the thermodynamic knowledge of the attandents in irreversible processes and provides insight into the fundamentals of reactive flows.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.26 Module: Major Field: Fluid Mechanic (SP 41) [M-MACH-102634]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt (p))

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election block: Strömungsmechanik (K) (at least 8 credits)			
T-MACH-105512	Experimental Fluid Mechanics	4 CR	Kriegseis
T-BGU-109581	Fluid Mechanics of Turbulent Flows	4 CR	Uhlmann
T-MACH-105533	Gasdynamics	4 CR	Magagnato
T-MACH-105425	Hydrodynamic Stability: From Order to Chaos	4 CR	Class
T-MACH-105338	Numerical Fluid Mechanics	4 CR	Magagnato
T-MACH-105400	Scaling in Fluid Dynamics	4 CR	Bühler
T-MACH-105784	Vortex Dynamics	4 CR	Kriegseis
T-BGU-106758	Numerical Fluid Mechanics	6 CR	Uhlmann
Election block: Strömungsmechanik (E) (at most 6 credits)			
T-MACH-105528	Aerodynamics	4 CR	Frohnapfel, Ohle
T-MACH-105437	Aerothermodynamics	4 CR	Frohnapfel, Seiler
T-MACH-105474	Fluid-Structure-Interaction	4 CR	Frohnapfel, Mühlhausen
T-MACH-105424	Optical Flow Measurement: Fundamentals and Applications	4 CR	Frohnapfel, Seiler
T-MACH-105375	Industrial Aerodynamics	4 CR	Breitling, Frohnapfel
T-MACH-105426	Magnetohydrodynamics	4 CR	Bühler
T-MACH-105295	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel
T-MACH-105420	Numerical Simulation of Multi-Phase Flows	4 CR	Wörner
T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	4 CR	Koch
T-MACH-105397	Numerical Simulation of Turbulent Flows	4 CR	Grötzbach
T-MACH-105422	Flows with Chemical Reactions	4 CR	Class
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-105406	Two-Phase Flow and Heat Transfer	4 CR	Schulenberg, Wörner
Election block: Strömungsmechanik (P) (at most 4 credits)			
T-MACH-105313	CFD-Lab Using OpenFOAM	4 CR	Koch
T-MACH-105515	Introduction to Numerical Fluid Dynamics	4 CR	Pritz
T-MACH-105453	Numerical Fluid Mechanics with MATLAB	4 CR	Frohnapfel
T-MACH-105458	Flow Simulations	4 CR	Frohnapfel

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After having completed this module the student is capable of deriving the relevant fluid mechanical equations and interpret the governed physics. He/She can describe the characteristic properties of fluids and can analyze flow scenarios. According to the chosen lectures, the student can capture flow scenarios with analytical, numerical and/or experimental means and is capable to evaluate the acquired results thoroughly.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

10.27 Module: Major Field: Fundamentals of Energy Technology (SP 15) [M-MACH-102623]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (mandatory)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-105220	Fundamentals of Energy Technology	8 CR	Badea, Cheng
Election block: Grundlagen der Energietechnik (K) ()			
T-MACH-105525	Introduction to Nuclear Energy	4 CR	Cheng
T-MACH-105325	Fundamentals of Combustion II	4 CR	Maas
T-MACH-105326	Hydraulic Fluid Machinery	8 CR	Pritz
Election block: Grundlagen der Energietechnik (E) (at most 8 credits)			
T-MACH-105462	Selected Problems of Applied Reactor Physics and Exercises	4 CR	Dagan
T-MACH-105184	Fuels and Lubricants for Combustion Engines	4 CR	Kehrwald, Kubach
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Braun, Schönung
T-MACH-105952	Energy Storage and Network Integration	4 CR	Jäger, Stieglitz
T-MACH-105408	Energy Systems I: Renewable Energy	6 CR	Dagan
T-MACH-105533	Gasdynamics	4 CR	Magagnato
T-MACH-105167	Analysis Tools for Combustion Diagnostics	4 CR	Pfeil
T-MACH-105557	Microenergy Technologies	4 CR	Kohl
T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	4 CR	Koch
T-MACH-105338	Numerical Fluid Mechanics	4 CR	Magagnato
T-ETIT-101939	Photovoltaics	6 CR	Powalla
T-MACH-105537	Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle	2 CR	Dagan
T-MACH-106493	Solar Thermal Energy Systems	4 CR	Dagan
T-MACH-105403	Flows and Heat Transfer in Energy Technology	4 CR	Cheng
T-MACH-105358	Sustainable Product Engineering	4 CR	Albers, Matthiesen, Ziegahn
T-MACH-105225	Thermal Solar Energy	4 CR	Stieglitz
T-MACH-105363	Thermal Turbomachines I	6 CR	Bauer
T-MACH-102194	Combustion Engines I	4 CR	Koch, Kubach
T-MACH-105234	Windpower	4 CR	Lewald
Election block: Grundlagen der Energietechnik (P) (at most 4 credits)			
T-MACH-105313	CFD-Lab Using OpenFOAM	4 CR	Koch
T-MACH-105515	Introduction to Numerical Fluid Dynamics	4 CR	Pritz
T-MACH-105331	Laboratory Exercise in Energy Technology	4 CR	Bauer, Maas, Wirbser
T-MACH-106707	Workshop on computer-based flow measurement techniques	4 CR	Bauer

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After completion of SP 15 students are able:

- to describe the elements of an energy system and their complex interactions,
- to list different conventional energy sources and assess their static range,
- to name the fluctuating supply of renewable energies such as wind, solar radiation, ocean currents and tides etc. and describe its effects on the energy system,
- to assess the effects of external and internal economic, ecological and technical boundary conditions of energy systems and to derive approaches for an optimal mix of different energy technologies,
- to explain the operational principle of well-established power plants as well as of power plants based on renewable energies.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, tutorials.

M 10.28 Module: Major Field: Fusion Technology (SP 53) [M-MACH-102643]

Responsible: Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Fusionstechnologie (K) (at least 8 credits)			
T-MACH-105411	Fusion Technology A	4 CR	Stieglitz
T-MACH-105433	Fusion Technology B	4 CR	Stieglitz
T-ETIT-100663	Radiation Protection: Ionising Radiation	3 CR	Dössel
Election block: Fusionstechnologie (E) (at most 10 credits)			
T-MACH-105310	Design of Highly Stresses Components	4 CR	Aktaa
T-MACH-105407	CFD in Power Engineering	4 CR	Otic
T-MACH-106698	A holistic approach to power plant management	4 CR	Seidl, Stieglitz
T-MACH-105408	Energy Systems I: Renewable Energy	6 CR	Dagan
T-MACH-105434	Magnet Technology of Fusion Reactors	4 CR	Fietz, Weiss
T-MACH-105426	Magnetohydrodynamics	4 CR	Bühler
T-MACH-105435	Neutron Physics of Fusion Reactors	4 CR	Fischer
T-MACH-105456	Ten Lectures on Turbulence	4 CR	Otic
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-105406	Two-Phase Flow and Heat Transfer	4 CR	Schulenberg, Wörner
T-MACH-108784	Vacuum and Tritium Technology in Nuclear Fusion	4 CR	Bornschein, Day

Competence Certificate
Oral exam: Acceptance for the oral test only by certification of attendance of excercises
(can be given in english)
Duration: approximately 30 minutes

no tools or reference materials may be used during the exam

Competence Goal
Graduate in fusion technology acquire a fundamental knowledge of the fusion process and are enabled to deduce based on the physical boundary conditions technological and scientific engineering solutions to individual problems. Since fusion technology is intrinsically of interdisciplinary nature consisiting of physics, mechanics, thermal-hydraulics, material sciences and electrical engineering incorporates, the focus of this topic is mainly devoted to allow for the understanding of the underlying physics and moreover to enable the students of couple the different disciplines. Here, mainly mehtodologies and solution approaches are communicated to the gradiuates with the goal to capture critical issues within multi-physics problems, to identify central challenges within the given problem and to enable them to elaborate engineering solution concepts. Aside from the analysis of the relevance/importance of aspects within a complex multi-physics problem graduates are prepared to take decisions based on a solid physics basis and to formulate solution approaches.

The reliable handling of different physical phenomena from different disciplines and the methodological capability to tackle multi-physics questions and to extract from them central core issues qualifies the graduates for a competent and successful career not only in fusion technology but also in neighboring fields such energy energiering as well as process, chemical and environmental engineering both in the research and development context but also in the project management.

Prerequisites
None

Content

Actual energy situation and perspectives. Elementary particle physics, principles of nuclear fusion and nuclear fission. What is a plasma and how it can be confined? How stable is a plasma and condtions for an ignition , control of a plasma and transport in plasmas. Plasmas are confined contactless by means of magnetic fields. Hence fundamentals of the magnet technology, super-conductivity, materials in super-conductivity, fabrication and design of magnets are elaborated.A fusion reactor breeds is own fuel Tritium, which is radioactive. Tritium poses specific requirements regarding separation, conditioning and the fuel cycle, for which the physical and technological basis are outlined. Fusion plasmas are characterized by a small particle density and hence a vacuum is required. Simultaneously plasmas generate high temperatures and heat loads necessitating dedicated designs of plasma facing components at a considerable neutron irradiation. in both technology fields the tasks, requirements and challenges are formulated and how they translate to the current "state of the art" are illustrated. Moreover, an introduction into design criteria and calculation methods to select adequate vacuum pumps and to design plasma facing components is provided.

Recommendation

appreciated is knowldege in heat ans mass transfer as well as in electrical engineering

Basic knowledge in fluid mechanics, material sciences and physics

Workload

The work load is about 480 hours, corresponding to 16 credit points.

Learning type

Lecture, presentation (transparencies nearly exclusivley in english) complemented by print-outs and exercises

M 10.29 Module: Major Field: Information Technology (SP 18) [M-MACH-102624]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Informationstechnik (K) (at least 8 credits)			
T-MACH-105314	Computational Intelligence	4 CR	Jakob, Mikut, Reischl
T-MACH-105694	Data Analytics for Engineers	5 CR	Ludwig, Mikut, Reischl
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-105223	Machine Vision	8 CR	Lauer, Stiller
T-MACH-105335	Measurement II	4 CR	Stiller
T-MACH-105360	Computer Engineering	6 CR	Keller, Lorch
Election block: Informationstechnik (E) (at most 6 credits)			
T-MACH-102150	BUS-Controls	4 CR	Becker, Geimer
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-102128	Information Systems and Supply Chain Management	3 CR	Kilger
T-MACH-105328	Information Processing in Mechatronic Systems	4 CR	Kaufmann
T-INFO-101466	Information Processing in Sensor Networks	6 CR	Hanebeck
T-MACH-105187	IT-Fundamentals of Logistics	3 CR	Thomas
T-MACH-105169	Engine Measurement Techniques	4 CR	Bernhardt
T-MACH-107447	Reliability Engineering 1	3 CR	Konnov
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
Election block: Informationstechnik (P) (at most 4 credits)			
T-MACH-105370	Laboratory Mechatronics	4 CR	Lorch, Seemann, Stiller
T-MACH-105341	Lab Computer-Aided Methods for Measurement and Control	4 CR	Stiller
Election block: Informationstechnik (Ü) ()			
T-MACH-108889	BUS-Controls - Advance	0 CR	Daiß, Geimer

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

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

Competence Goal
Students are able to

- explain fundamentals of information technology for given problems in mechanical engineering an mechatronics.
- explain major methods for acquisition, processing and exploitation of information in technical systems.
- outline and to explain alternative methods to determine and to represent measurement uncertainties and their propagation in technical systems.
- explain information filters and fusion methods and understand their application to given problems.

Prerequisites
none

Content

- Techniques of information and data processing in mechanical engeneering
- Techniques of sensor data processing
- Concepts of controll theory
- Electronic devices for data processing

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, tutorials.

M 10.30 Module: Major Field: Information Technology of Logistic Systems (SP 19) [M-MACH-102625]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Informationstechnik für Logistiksysteme (K) (at least 8 credits)			
T-MACH-102128	Information Systems and Supply Chain Management	3 CR	Kilger
T-MACH-105187	IT-Fundamentals of Logistics	3 CR	Thomas
T-MACH-102089	Logistics - Organisation, Design and Control of Logistic Systems	6 CR	Furmans
Election block: Informationstechnik für Logistiksysteme (E) (at most 8 credits)			
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-105174	Warehousing and Distribution Systems	3 CR	Furmans
T-MACH-105175	Airport Logistics	3 CR	Richter
T-MACH-105181	Supply Chain Management	6 CR	Alicke

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Students are able to:

- Describe and explain soft- and hardware for logistical systems including Supply-Chains,
- Choose control mechanisms and communication systems and describe their basic functions,
- Compare strength and weaknesses of different approaches and evaluate the fundamental suitability.

Prerequisites
None

Content
This emphasis module focuses on automation technology in material flow as well as the information technology that has a direct relationship with it. Information sytems to support logistic processes are presented. It is shown how requirements of a supply chain can be identified and an appropriate information system can be choosen. Furthermore basic for the main topics of logistics are provided. To gain a deeper understanding, the courses are accompanied by exercises and partly by case studies.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures and practices; self-study

10.31 Module: Major Field: Innovation and Entrepreneurship (SP 59) [M-MACH-104323]

Responsible: Prof. Dr. Andreas Class
Prof. Dr. Orestis Terzidis

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)

Credits	Language	Level	Version
16	English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Innovation und Entrepreneurship (K) (at least 8 credits)			
T-WIWI-102866	Design Thinking	3 CR	Terzidis
T-WIWI-102864	Entrepreneurship	3 CR	Terzidis
T-MACH-109185	Innvative Project	6 CR	Class, Terzidis
Election block: Innovation und Entrepreneurship (E) (at most 11,5 credits)			
T-WIWI-107501	Energy Market Engineering	4,5 CR	Weinhardt
T-WIWI-100806	Renewable Energy-Resources, Technologies and Economics	4 CR	Jochem, McKenna
T-WIWI-102865	Business Planning	3 CR	Terzidis

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

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

Competence Goal
After completion of the module students

- know the principles of innovation and entrepreneurship
- can initiate patent research
- can name, compare and use the central methods and process models of product development within moderate complex technical systems.

Prerequisites
none

Content
The module introduces the basic concepts of entrepreneurship and illustrates the different stages of the dynamic development of a company.

The topics include:

- introduction to methods for generating innovative business ideas
- translating patents into business concepts
- general principles of financial planning
- the design and implementation of service-oriented information systems for Entrepreneurs
- Technology Management and Business Model Generation and "Lean Startup" methods for the implementation of business ideas by the way of controlled experiments in the market
- basics of product development.

Workload
The work load is about 480 hours, corresponding to 16 credit points. 1 LP = 30 working hours

Learning type
Seminar, lecture, project

M 10.32 Module: Major Field: Integrated Product Development [M-MACH-102626]

Responsible: Prof. Dr.-Ing. Albert Albers
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt (p))
Specialization / Specialization: Production Technology (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German	4	2

Mandatory			
T-MACH-105401	Integrated Product Development	16 CR	Albers, Albers Assistenten

Competence Certificate
oral examination (60 minutes)

Competence Goal
By working practically in experience-based learning arrangements with industrial development tasks, graduates are able to succeed in new and unknown situations when developing innovative products by using methodological and systematic approaches. They can apply and adapt strategies of development and innovation management, technical system analysis and team leadership to the situation. As a result, they are able to foster the development of innovative products in industrial development teams in prominent positions, taking into account social, economic and ethical aspects.

Prerequisites
None

Content
Organizational integration: integrated product development model, core team management and simultaneous engineering, informational integration: innovation management, cost management, quality management and knowledge management

Personal integration: team development and leadership

Guest lectures from the industry

Annotation
The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and project work (2145300).

Due to organizational reasons, the number of participants is limited. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK hompage from april to july. The selection itself is made by Prof. Albers in personal interviews.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
lecture
tutorial
product development project

10.33 Module: Major Field: Lifecycle Engineering (SP 28) [M-MACH-102613]

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

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt (p))
Specialization / Specialization: Production Technology (Schwerpunkt (p))

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-102123	Virtual Engineering I	4 CR	Ovtcharova
T-MACH-102124	Virtual Engineering II	4 CR	Ovtcharova
Election block: Lifecycle Engineering (E) (at most 11 credits)			
T-MACH-109933	Business Administration for Engineers and IT professionals	4 CR	Sebregondi
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-105312	CATIA Advanced	4 CR	Ovtcharova
T-MACH-108491	Digitalization of Products, Services & Production	4 CR	Pätzold
T-MACH-106374	Human-oriented Productivity Management: Personnel Management	4 CR	Stock
T-MACH-105388	Introduction to Industrial Production Economics	4 CR	Dürrschnabel
T-MACH-102209	Information Engineering	3 CR	Ovtcharova
T-MACH-106743	IoT Platform for Engineering	4 CR	Ovtcharova
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MACH-102181	PLM for Product Development in Mechatronics	4 CR	Eigner
T-MACH-105147	Product Lifecycle Management	4 CR	Ovtcharova
T-MACH-105523	Productivity Management in Production Systems	4 CR	Stowasser
T-MACH-105457	Project Mikromanufacturing: Development and Manufacturing of Microsystems	5 CR	Schulze
T-MACH-105171	Safety Engineering	4 CR	Kany
T-MACH-105181	Supply Chain Management	6 CR	Alicke
T-MACH-105358	Sustainable Product Engineering	4 CR	Albers, Matthiesen, Ziegahn
T-MACH-106741	Virtual Training Factory 4.X	4 CR	Ovtcharova
T-MACH-106740	Virtual Engineering Lab	4 CR	Ovtcharova
T-MACH-102187	CAD-NX Training Course	2 CR	Ovtcharova

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

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

Competence Goal

Student gain a basic understanding of holistic development, validation and production of products, components and systems.

Students are able to appreciate the product and process complexity of today's products and manufacturing facilities. They know exemplary IT-Systems to support the complexity.

Students can describe the necessary information management for the product emergence process.

Students know the fundamental terms or virtual reality and are able to use a CAVE as tool to promote technical or management decisions.

Prerequisites

None

Content

Virtual Engineering, methods of product development and production, CAD, CAE, CAx, Virtual and Augmented Reality, digital twin.

Workload

The work load is about 480 hours, corresponding to 16 credit points.

Learning type

Lectures, exercises, project work in teams, workshop, Learning by Doing

M 10.34 Module: Major Field: Lightweight Construction (SP 25) [M-MACH-102628]

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

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Materials and Structures for High Performance Systems (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	3

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	4 CR	Henning
Election block: Leichtbau (E) ()			
T-MACH-108844	Automated Manufacturing Systems	8 CR	Fleischer
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-108721	Designing with Composites	4 CR	Schnack
T-MACH-105320	Introduction to the Finite Element Method	4 CR	Böhlke, Langhoff
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Braun, Schönung
T-MACH-105157	Foundry Technology	4 CR	Wilhelm
T-MACH-105330	Design with Plastics	4 CR	Liedel
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
T-MACH-105164	Laser in Automotive Engineering	4 CR	Schneider
T-MACH-108717	Mechanics of Laminated Composites	4 CR	Schnack
T-MACH-102137	Polymer Engineering I	4 CR	Elsner
T-MACH-105971	Simulation of the process chain of continuously fiber reinforced composite structure	4 CR	Kärger
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger
T-MACH-102139	Failure of Structural Materials: Fatigue and Creep	4 CR	Gruber, Gumbsch
T-MACH-102140	Failure of Structural Materials: Deformation and Fracture	4 CR	Gumbsch, Weygand
T-MACH-105211	Materials of Lightweight Construction	4 CR	Liebig
T-MACH-108878	Laboratory Production Metrology	4 CR	Häfner
T-MACH-110318	Product- and Production-Concepts for modern Automobiles	4 CR	Kienzle, Steegmüller
T-MACH-110377	Advanced Methods in Strength of Materials	4 CR	Böhlke, Frohnapfel
T-MACH-110333	Tutorial Continuum Mechanics of solids and fluids	1 CR	Böhlke, Frohnapfel
T-MACH-110330	Tutorial Introduction to the Finite Element Method	1 CR	Böhlke, Langhoff

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal

Lightweight design is the realization of a development strategy, which aims at fulfilling a required function over the product life under specified boundary conditions by a system of minimal weight.

Therefore, lightweight design can always be described as an optimization problem, that must be solved as efficiently as possible by suitable measures. With regard to the automotive industry, this means reducing the total vehicle weight without negatively affecting important properties such as the bodywork stiffness or crash characteristics.

In order to solve the optimization problem of lightweight design technically and economically efficient, an interdisciplinary approach is required. This means that specific know-how is required in many areas of materials science and engineering, as well as interdisciplinary thinking.

Exploiting the full potential of lightweight design therefore requires the systematic development of materials, the development and adaption of suitable manufacturing and finishing processes, as well as the development of simulation tools and design methods for innovative lightweight constructions.

Students acquire the skill to name the basics of lightweight design and to apply them to problems in various areas of mechanical engineering, in particular materials, methods and production.

As an elementary component of the module, the students can explain and apply the materials relevant for lightweight design. The students are able to describe and compare the materials important for lightweight design and to select the corresponding methods for construction, design and dimensioning under consideration of suitable manufacturing technologies.

Based on examples, which are also used in industry, the students learn to select suitable materials, to describe them with suitable methods and to develop products under consideration of the manufacturing process. The students learn to analyze processes and to assess their efficiency.

Prerequisites

None

Content

See brick courses.

Workload

The work load is about 480 hours, corresponding to 16 credit points.

Learning type

Lectures, Tutorials

10.35 Module: Major Field: Logistics and Material Flow Theory (SP 29) [M-MACH-102629]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt (p))

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Mandatory			
T-MACH-102151	Material Flow in Logistic Systems	9 CR	Furmans
Election block: Logistik und Materialflusslehre (E) ()			
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Braun, Schönung
T-MACH-108848	Global Production and Logistics - Part 1: Global Production	4 CR	Lanza
T-MACH-105159	Global Production and Logistics - Part 2: Global Logistics	4 CR	Furmans
T-MACH-102128	Information Systems and Supply Chain Management	3 CR	Kilger
T-MACH-105174	Warehousing and Distribution Systems	3 CR	Furmans
T-MACH-105175	Airport Logistics	3 CR	Richter
T-WIWI-103091	Production and Logistics Controlling	3 CR	Rausch
T-MACH-105523	Productivity Management in Production Systems	4 CR	Stowasser
T-MACH-105346	Production Techniques Laboratory	4 CR	Deml, Fleischer, Furmans, Ovtcharova
T-MACH-105171	Safety Engineering	4 CR	Kany

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Students

- acquire comprehensive and well-founded knowledge on the main topics of logistics, an overview of different logistic questions in practice and knows the functionality of material handling systems,
- are able to illustrate logistic systems with adequate accuracy by using simple models,
- are able to realize coherences within logistic systems,
- are able to evaluate logistic systems by using the learnt methods,
- are able to analyze and explain the phenomena of industrial material and value streams
- are able to plan logistic systems and evaluate their performance,
- can use approaches of Supply Chain Management within the operational practice,
- identify, analyse and evaluate risks within logistic systems.

Prerequisites
None

Content
The emphasis module *Material Flow and Logistics* provides comprehensive and well-founded basics for the main topics of logistics. Within the lectures, the interaction between several components of logistic systems will be shown. The module focuses on technical characteristics of material handling systems as well as on methods for illustrating and evaluating logistics systems. Furthermore the main topics of logistics and industrial material and value streams can be focused on by queuing methods to model production systems. Another focus can be set on basic methods for planning and running logistic systems or special issues like supply chain management. To gain a deeper understanding, the courses are accompanied by exercises and partly by case studies.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures and practices; self-study

M 10.36 Module: Major Field: Man - Technology - Organisation (SP 03) [M-MACH-102600]

Responsible: Prof. Dr.-Ing. Barbara Deml

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt (p))

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-105518	Human Factors Engineering I	4 CR	Deml
T-MACH-105519	Human Factors Engineering II	4 CR	Deml
Election block: Mensch - Technik - Organisation (E) (at most 8 credits)			
T-MACH-105830	Human Factors Engineering III: Empirical research methods	4 CR	Deml
T-MACH-108374	Vehicle Ergonomics	4 CR	Heine
T-MACH-106374	Human-oriented Productivity Management: Personnel Management	4 CR	Stock
T-MACH-105388	Introduction to Industrial Production Economics	4 CR	Dürrschnabel
T-MACH-105386	Occupational Safety and Environmental Protection	4 CR	von Kiparski
T-MACH-105231	Leadership and Management Development	4 CR	Albers, Matthiesen, Ploch
T-MACH-105440	Leadership and Conflict Management	4 CR	Hatzl
T-MACH-105387	Planning of Assembly Systems	4 CR	Haller
T-MACH-105470	Production Planning and Control	4 CR	Rinn
T-MACH-105523	Productivity Management in Production Systems	4 CR	Stowasser
T-MACH-105171	Safety Engineering	4 CR	Kany
T-MACH-105361	Technical Design in Product Development	4 CR	Albers, Matthiesen, Schmid

Competence Certificate
In the core area of Major Field at least 8 ECTS have to be chosen.

Competence Goal
The students acquire a basic knowledge in the field of 1. ergonomics and 2. work organisation:

1. They are able to consider cognitive, physiological, anthropometric, and safety technical aspects in order to design workplaces ergonomically. Just as well they know physical and psycho-physical fundamentals (e. g. noise, lighting, climate) in the field of work-environmental design. Furthermore the students are able to evaluate workplaces by knowing and being able to apply essential methods of time studies and payment systems. Finally, they get a first, overall insight into the German labour law as well as into the organisation of advocacy groups beyond companies.
2. Within this module the students gain also a fundamental knowledge in the field of structural, process, and production organization. Besides, they get to know basic aspects of industrial teamwork and they know relevant theories in the field of interaction and communication, the management of employees as well as work satisfaction and motivation. Finally, the students get to know also methods in the field of personnel selection, development, and assessment.

Further on they get to know basic methods of behavioral-science data acquisition (e. g. eye-tracking, ECG, dual-task-paradigm) and they gain a first insight into empirical research methods (e. g. experimental design, statistical data evaluation). Selected complementary subjects deepen or extend the above mentioned learning outcomes.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.37 Module: Major Field: Materials Science and Engineering (SP 26) [M-MACH-102611]

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

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)
Specialization / Specialization: Materials and Structures for High Performance Systems (Schwerpunkt (p))

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-105301	Materials Science and Engineering III	8 CR	Heilmaier
Election block: Materialwissenschaft und Werkstofftechnik (E) ()			
T-MACH-105308	Atomistic Simulations and Molecular Dynamics	4 CR	Brandl, Gumbsch, Schneider
T-MACH-102141	Constitution and Properties of Wearresistant Materials	4 CR	Ulrich
T-MACH-105150	Constitution and Properties of Protective Coatings	4 CR	Ulrich
T-MACH-105984	Fatigue of Welded Components and Structures	3 CR	Farajian, Gumbsch
T-MACH-105157	Foundry Technology	4 CR	Wilhelm
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	4 CR	Schell
T-MACH-108717	Mechanics of Laminated Composites	4 CR	Schnack
T-MACH-100287	Introduction to Ceramics	6 CR	Hoffmann
T-MACH-105330	Design with Plastics	4 CR	Liedel
T-MACH-105164	Laser in Automotive Engineering	4 CR	Schneider
T-MACH-105333	Mechanics and Strength of Polymers	4 CR	von Bernstorff
T-MACH-105303	Modelling of Microstructures	5 CR	August, Nestler
T-MACH-105532	Nonlinear Continuum Mechanics	5 CR	Böhlke
T-MACH-105516	Multi-Scale Plasticity	4 CR	Greiner, Schulz
T-MACH-102137	Polymer Engineering I	4 CR	Elsner
T-MACH-102157	High Performance Powder Metallurgy Materials	4 CR	Schell
T-MACH-105724	Failure Analysis	4 CR	Greiner, Schneider
T-MACH-105170	Welding Technology	4 CR	Farajian
T-MACH-105354	Fatigue of Metallic Materials	4 CR	Guth, Lang
T-MACH-102179	Structural Ceramics	4 CR	Hoffmann
T-MACH-105362	Technology of Steel Components	4 CR	Schulze
T-MACH-108853	Hydrogen in Materials	4 CR	Pundt
T-MACH-102139	Failure of Structural Materials: Fatigue and Creep	4 CR	Gruber, Gumbsch
T-MACH-102140	Failure of Structural Materials: Deformation and Fracture	4 CR	Gumbsch, Weygand
T-MACH-107684	Materials Characterization	4 CR	Gibmeier
T-MACH-105211	Materials of Lightweight Construction	4 CR	Liebig
T-MACH-107667	Solid State Reactions and Kinetics of Phase	4 CR	Franke, Seifert

T-MACH-105369	Materials Modelling: Dislocation Based Plasticy	4 CR	Weygand
T-MACH-107670	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	4 CR	Franke, Seifert
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger
T-MACH-110165	Materials in Additive Manufacturing	4 CR	Dietrich
T-MACH-110378	Mathematical Methods in Micromechanics	5 CR	Böhlke
T-MACH-110268	Plasticity of metals and intermetallics	4 CR	Kauffmann
Election block: Materialwissenschaft und Werkstofftechnik (P) (at most 4 credits)			
T-MACH-105447	Metallographic Lab Class	4 CR	Hauf
T-MACH-102154	Laboratory Laser Materials Processing	4 CR	Schneider
T-MACH-105651	Biomechanics: design in nature and inspired by nature	4 CR	Mattheck
Election block: Materialwissenschaft und Werkstofftechnik (Ü) ()			
T-MACH-107685	Exercises for Materials Characterization	2 CR	Gibmeier
T-MACH-107632	Exercises for Solid State Reactions and Kinetics of Phase Transformations	2 CR	Franke, Seifert
T-MACH-110379	Tutorial Mathematical Methods in Micromechanics	1 CR	Böhlke

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

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

Competence Goal
As part of a major field a specific subdomain of mechanical engineering is made accessible in breadth and depth. Students gain comprehensive knowledge in the core subjects and detailed knowledge in the supplementary subjects of the selected subdomain. They are able to generate new (scientific) solutions within this subdomain.

The specific learning outcomes are defined by the respective coordinator of the major field.

Prerequisites
None

Content
The comprehensive topic of the major field are the thermodynamical and kinetic basics of materials science that the students acquire within the core area (8 credit points). Moreover, there is a supplementary area of materials science and engineering which offers different subjects according to the students' interests.

Annotation
The module Materials Science and Engineering consists of 16 credit points in the master´s program. Within that module, the students have to take lectures from a core area (8 credit points) and can select from a broad variation of courses within the supplementary area. For the bachelor´s program, a reduced catalogue exists (see Studienplan).

Workload
The work load is about 480 hours in the Master of Science program, whereof the presence time is 82 h.

Learning type
In the core area of the major field Materials Science and Engineering the students choose from a small number of lectures and tutorials (obligatory).

Within the supplementary area students can choose not only lectures and tutorials but also lab courses and seminars.

M 10.38 Module: Major Field: Mechatronics (SP 31) [M-MACH-102614]

Responsible: Prof. Dr. Veit Hagenmeyer
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt (p))
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	4

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Mechatronik (K) (at least 8 credits)			
T-MACH-105314	Computational Intelligence	4 CR	Jakob, Mikut, Reischl
T-MACH-105694	Data Analytics for Engineers	5 CR	Ludwig, Mikut, Reischl
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-105539	Modern Control Concepts I	4 CR	Groell, Matthes
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
Election block: Mechatronik (E) (at most 5 credits)			
T-MACH-105217	Automation Systems	4 CR	Kaufmann
T-MACH-102150	BUS-Controls	4 CR	Becker, Geimer
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-105514	Experimental Dynamics	5 CR	Fidlin
T-ETIT-100784	Hybrid and Electric Vehicles	4 CR	Becker
T-MACH-105187	IT-Fundamentals of Logistics	3 CR	Thomas
T-MACH-108957	Mathematical Fundamentals of Numerical Mechanics	4 CR	Schnack
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-INFO-101266	Human-Machine-Interaction	6 CR	Beigl
T-MACH-105334	Mechanics in Microtechnology	4 CR	Greiner, Gruber
T-MACH-105335	Measurement II	4 CR	Stiller
T-MACH-105557	Microenergy Technologies	4 CR	Kohl
T-MACH-108809	Micro- and nanosystem integration for medical, fluidic and optical applications	4 CR	Gengenbach, Hagenmeyer, Koker, Sieber
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-MACH-105372	Theory of Stability	6 CR	Fidlin

T-MACH-105358	Sustainable Product Engineering	4 CR	Albers, Matthiesen, Ziegahn
T-MACH-105555	System Integration in Micro- and Nanotechnology	4 CR	Gengenbach
T-MACH-105521	Theoretical Description of Mechatronic Systems	4 CR	Seemann
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
Election block: Mechatronik (P) (at most 4 credits)			
T-MACH-105370	Laboratory Mechatronics	4 CR	Lorch, Seemann, Stiller
T-MACH-108878	Laboratory Production Metrology	4 CR	Häfner
T-MACH-105373	Practical Training in Measurement of Vibrations	4 CR	Fidlin
T-MACH-102149	Virtual Reality Practical Course	4 CR	Ovtcharova
Election block: Mechatronik (Ü) ()			
T-MACH-108889	BUS-Controls - Advance	0 CR	Daiß, Geimer
T-INFO-106257	Human-Machine-Interaction Pass	0 CR	Beigl

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The topic mechatronics offers a broad, multidisciplinary body of knowledge. The graduates are qualified to solve essential mechatronic questions. In particular the following disciplines are covered by the major mechatronics:

§ Mechanics and fluidics

§ Electronics

§ Information processing

§ Automation.

Students of the topic mechatronics know the future-oriented procedures. They are able to individually and creatively solve interdisciplinary questions and learn to effectively combine tools from the individual disciplines.

Prerequisites
none

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, tutorial.

M 10.39 Module: Major Field: Medical Technology (SP 32) [M-MACH-102615]

Responsible: Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
Election block: Medizintechnik (K) (at least 2 credits)			
T-ETIT-106492	Biomedical Measurement Techniques I	3 CR	Nahm
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-105314	Computational Intelligence	4 CR	Jakob, Mikut, Reischl
T-MACH-105694	Data Analytics for Engineers	5 CR	Ludwig, Mikut, Reischl
T-MACH-105235	Principles of Medicine for Engineers	4 CR	Pylatiuk
Election block: Medizintechnik (E) (at most 8 credits)			
T-MACH-105238	Actuators and Sensors in Nanotechnology	4 CR	Kohl
T-ETIT-101930	Medical Imaging Techniques I	3 CR	Dössel
T-ETIT-101931	Medical Imaging Techniques II	3 CR	Dössel
T-ETIT-101956	Bioelectric Signals	3 CR	Loewe
T-ETIT-106973	Biomedical Measurement Techniques II	3 CR	Nahm
T-MACH-102172	Bionics for Engineers and Natural Scientists	4 CR	Hölscher
T-INFO-101262	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	3 CR	Dillmann, Spetzger
T-MACH-105228	Organ Support Systems	4 CR	Pylatiuk
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
T-MACH-105334	Mechanics in Microtechnology	4 CR	Greiner, Gruber
T-ETIT-101937	Measurement	5 CR	Puente León
T-MACH-108809	Micro- and nanosystem integration for medical, fluidic and optical applications	4 CR	Gengenbach, Hagenmeyer, Koker, Sieber
T-ETIT-100664	Nuclear Medicine and Measuring Techniques I	1 CR	Dössel
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-105457	Project Mikromanufacturing: Development and Manufacturing of Microsystems	5 CR	Schulze
T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-INFO-108014	Robotics I - Introduction to Robotics	6 CR	Asfour

T-INFO-105723	Robotics II: Humanoid Robotics	3 CR	Asfour
T-INFO-101352	Robotics III - Sensors in Robotics	3 CR	Asfour
T-INFO-101357	Medical Robotics	3 CR	Kröger, Mathis-Ullrich
T-MACH-105990	Simulation of Optical Systems	4 CR	Sieber
T-MACH-105555	System Integration in Micro- and Nanotechnology	4 CR	Gengenbach
T-MACH-102164	Practical Training in Basics of Microsystem Technology	4 CR	Last

Competence Certificate
In the core area of Major Field at least 8 ECTS have to be chosen.

Competence Goal
The Medical Engineering qualifies students to solve challenges in the field of complex medical and biomedical systems supporting human-centred diagnostics and therapy. Based on the specific requirements for medical products the following topics are taught within the major Medical Engineering:

- Broad basis of relevant medical and biological knowledge
- Measuring technology and signal processing
- Development and Manufacturing of medical products

Graduates of this major know all relevant methods to design modern medical devices and have the ability to efficiently and creatively develop solutions for leading edge medical applications.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.40 Module: Major Field: Microactuators and Microsensors (SP 54) [M-MACH-102647]

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

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Mikroaktoren und Mikrosensoren (K) (at least 8 credits)			
T-MACH-101910	Microactuators	4 CR	Kohl
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
Election block: Mikroaktoren und Mikrosensoren (E) (at most 11 credits)			
T-MACH-105238	Actuators and Sensors in Nanotechnology	4 CR	Kohl
T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	4 CR	Guber
T-MACH-105321	Introduction to Theory of Materials	4 CR	Kamlah
T-MACH-102166	Fabrication Processes in Microsystem Technology	4 CR	Bade
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink
T-MACH-105334	Mechanics in Microtechnology	4 CR	Greiner, Gruber
T-MACH-105557	Microenergy Technologies	4 CR	Kohl
T-MACH-105303	Modelling of Microstructures	5 CR	August, Nestler
T-MACH-105180	Nanotechnology for Engineers and Natural Scientists	4 CR	Dienwiebel, Hölscher, Walheim
T-INFO-108014	Robotics I - Introduction to Robotics	6 CR	Asfour
T-MACH-105555	System Integration in Micro- and Nanotechnology	4 CR	Gengenbach
T-MACH-105782	Micro Magnetic Resonannce	4 CR	Korvink, MacKinnon

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
- Knowledge of the principles of actuation and sensing including pros and cons
- Knowledge of the underlying concepts of materials science and technology
on different lengths scales
- Explanation of layout and function of important actuators and sensors
- Calculation of important properties (time constants, forces, displacements,
sensitivity, etc.)
- Development of a layout based on specifications

Prerequisites
none

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, exercise.

10.41 Module: Major Field: Microsystem Technology (SP 33) [M-MACH-102616]

Responsible: Dr. Arndt Last

Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt (p))
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink
Election block: Mikrosystemtechnik (E) (at most 10 credits)			
T-MACH-105238	Actuators and Sensors in Nanotechnology	4 CR	Kohl
T-MACH-102176	Current Topics on BioMEMS	4 CR	Guber
T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	4 CR	Guber
T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	4 CR	Guber
T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	4 CR	Guber
T-MACH-102172	Bionics for Engineers and Natural Scientists	4 CR	Hölscher
T-MACH-102166	Fabrication Processes in Microsystem Technology	4 CR	Bade
T-MACH-105334	Mechanics in Microtechnology	4 CR	Greiner, Gruber
T-MACH-105557	Microenergy Technologies	4 CR	Kohl
T-MACH-101910	Microactuators	4 CR	Kohl
T-MACH-108383	Microsystem Simulation	4 CR	Korvink
T-MACH-105814	Microsystem product design for young entrepreneurs	6 CR	Korvink
T-MACH-108613	Miniaturized Heat Exchangers	4 CR	Brandner
T-MACH-105180	Nanotechnology for Engineers and Natural Scientists	4 CR	Dienwiebel, Hölscher, Walheim
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
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-109122	X-ray Optics	4 CR	Last
Election block: Mikrosystemtechnik (P) (at most 4 credits)			
T-MACH-108407	NMR micro probe hardware conception and construction	4 CR	Korvink
T-MACH-105556	Practical Course Polymers in MEMS	2 CR	Rapp, Worgull
T-MACH-102164	Practical Training in Basics of Microsystem Technology	4 CR	Last
T-MACH-105782	Micro Magnetic Resonannce	4 CR	Korvink, MacKinnon

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
In this key area, attendees gain competence in the design, construction, production, and application of **micro and nano systems**. Microsystems comprise the **smallest human-made** components. These include sensors, actuators, and system components working together for form a more powerful whole. Micro and nano systems are the basis for numerous smart products, such as **smart dust**, smart buildings, the **internet of things**, smart consumer-ware, smart mobility, and smart production via **industry 4.0** concepts.

The **increasing control** over morphology at the nano and microscale is enabling the bottom up construction of **passive and active materials** with ideal and unheard-of properties, embedded in the devices that can make use of these, and are therefore **revolutionising** the world of products and scientific instrumentation.

Prerequisites
none

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

10.42 Module: Major Field: Mobile Machines (SP 34) [M-MACH-102630]

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

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Vehicle Technology (Schwerpunkt (p))
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-105168	Mobile Machines	8 CR	Geimer
Election block: Mobile Arbeitsmaschinen (E) ()			
T-MACH-105307	Drive Train of Mobile Machines	4 CR	Geimer, Wydra
T-MACH-105311	Design and Development of Mobile Machines	4 CR	Geimer, Siebert
T-MACH-102150	BUS-Controls	4 CR	Becker, Geimer
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Braun, Schönung
T-MACH-108374	Vehicle Ergonomics	4 CR	Heine
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-105160	Fundamentals in the Development of Commercial Vehicles I	2 CR	Zürn
T-MACH-105161	Fundamentals in the Development of Commercial Vehicles II	2 CR	Zürn
T-MACH-102093	Fluid Power Systems	4 CR	Geimer, Pult
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Ays, Geerling
T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-MACH-105172	Simulation of Coupled Systems	4 CR	Geimer, Xiang
T-MACH-105423	Tractors	4 CR	Becker, Geimer, Kremmer
T-MACH-102194	Combustion Engines I	4 CR	Koch, Kubach
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
Election block: Mobile Arbeitsmaschinen (Ü) ()			
T-MACH-108889	BUS-Controls - Advance	0 CR	Daiß, Geimer
T-MACH-108888	Simulation of Coupled Systems - Advance	0 CR	Geimer, Xiang
T-MACH-108887	Design and Development of Mobile Machines - Advance	0 CR	Geimer, Siebert

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The student

- knows and understands the basic structure of the machines,
- masters the basic skills to develop the selected machines

Prerequisites
None

Content

- Introduction of the required components and machines
- Basics of the structure of the whole system
- Practical insight in the development techniques

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type

- Research-oriented teaching
- lectures
- exercises

10.43 Module: Major Field: Modeling and Simulation in Dynamics (SP 61) [M-MACH-104434]

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

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt (p))

Credits	Language	Level	Version
16	German/English	4	2

Election notes
In the core area of each Major Field at least 8 ECTS have to be chosen.

Election block: Modellbildung und Simulation in der Dynamik (K) (at least 8 credits)			
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-105226	Dynamics of the Automotive Drive Train	5 CR	Fidlin
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
Election block: Modellbildung und Simulation in der Dynamik (E) (at most 9 credits)			
T-MACH-105308	Atomistic Simulations and Molecular Dynamics	4 CR	Brandl, Gumbsch, Schneider
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105172	Simulation of Coupled Systems	4 CR	Geimer, Xiang
T-MACH-105514	Experimental Dynamics	5 CR	Fidlin
T-MACH-105349	Computational Dynamics	4 CR	Proppe
T-MACH-105384	Computerized Multibody Dynamics	4 CR	Seemann
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-105350	Computational Vehicle Dynamics	4 CR	Proppe
Election block: Modellbildung und Simulation in der Dynamik (Ü) ()			
T-MACH-108888	Simulation of Coupled Systems - Advance	0 CR	Geimer, Xiang

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

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

Competence Goal
The module provides modeling competences and continues thus the compulsory courses in dynamics. To this end analytical methods for the modeling and examination of dynamical systems are presented. The simulation of the systems enables the students to do simulation studies in typical applications in dynamical systems of mechanical engineering to be able to evaluate and interpret the results.

Prerequisites
none

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points. 1 LP = 30 working hours.

Learning type
Lectures, Tutorials

10.44 Module: Major Field: Modeling and Simulation in Energy- and Fluid Engineering (SP 27) [M-MACH-102612]

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

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Modellierung und Simulation in der Energie- und Strömungstechnik (K) (at least 8 credits)			
T-MACH-105396	Modeling of Thermodynamical Processes	6 CR	Maas, Schießl
T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	4 CR	Koch
T-MACH-105338	Numerical Fluid Mechanics	4 CR	Magagnato
Election block: Modellierung und Simulation in der Energie- und Strömungstechnik (E) (at most 8 credits)			
T-MACH-105407	CFD in Power Engineering	4 CR	Otic
T-MACH-105533	Gasdynamics	4 CR	Magagnato
T-MACH-105419	Mathematical Models and Methods in Combustion Theory	4 CR	Bykov, Maas
T-MACH-105167	Analysis Tools for Combustion Diagnostics	4 CR	Pfeil
T-MACH-105420	Numerical Simulation of Multi-Phase Flows	4 CR	Wörner
T-MACH-105397	Numerical Simulation of Turbulent Flows	4 CR	Grötzbach
T-MACH-105421	Reduction Methods for the Modeling and the Simulation of Vombustion Processes	4 CR	Bykov, Maas
T-MACH-105422	Flows with Chemical Reactions	4 CR	Class
T-MACH-105403	Flows and Heat Transfer in Energy Technology	4 CR	Cheng
T-MACH-105456	Ten Lectures on Turbulence	4 CR	Otic
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-102149	Virtual Reality Practical Course	4 CR	Ovtcharova

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After completing the students can:

- formulate the governing equations for specific systems in energy and fluid mechanics.
- explain the different numerical schemes applied to solve the system of equations.
- use frequently applied simulation tools in a more efficient and successful way.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.45 Module: Major Field: Nuclear Energy (SP 21) [M-MACH-102608]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Kerntechnik (K) (at least 8 credits)			
T-MACH-105525	Introduction to Nuclear Energy	4 CR	Cheng
T-MACH-105402	Nuclear Power Plant Technology	4 CR	Badea, Cheng, Schulenberg
Election block: Kerntechnik (E) (at most 8 credits)			
T-MACH-105310	Design of Highly Stresses Components	4 CR	Aktaa
T-MACH-105407	CFD in Power Engineering	4 CR	Otic
T-MACH-105530	Fundamentals of reactor safety for the operation and dismantling of nuclear power plants	4 CR	Sanchez-Espinoza
T-MACH-105550	Energy systems II: Reactor Physics	4 CR	Badea
T-MACH-105404	Innovative Nuclear Systems	4 CR	Cheng
T-MACH-105466	Introduction to Neutron Cross Section Theory and Nuclear Data Generation	4 CR	Dagan
T-MACH-105405	Reactor Safety I: Fundamentals	4 CR	Sanchez-Espinoza
T-MACH-105403	Flows and Heat Transfer in Energy Technology	4 CR	Cheng
T-MACH-105456	Ten Lectures on Turbulence	4 CR	Otic
T-MACH-105406	Two-Phase Flow and Heat Transfer	4 CR	Schulenberg, Wörner
T-MACH-110331	Nuclear Fusion Technology	4 CR	Badea
T-MACH-110332	Nuclear Power and Reactor Technology	4 CR	Badea

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Students acquire the basic and advanced knowledge of nuclear technology and are able to apply the assimilated knowledge in practice and to analyze and solve by themselves important questions in the nuclear energy field.

The courses of this module are built on three levels. With the overview lecture "Introduction into Nuclear Power", the students acquire broad basic knowledge of nuclear energy and are able to further study in-depth courses in various disciplines, namely thermal-hydraulics, reactor physics and materials science. As a result, students will understand the important processes of nuclear technology, such as control, heat transport and material behavior in a nuclear reactor. The properties of various nuclear systems, especially nuclear power plants, are available for study on the third level of the lectures. The students will possess then the ability to compare and analyze different nuclear systems.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.46 Module: Major Field: Polymer Engineering (SP 36) [M-MACH-102632]

Responsible: Prof. Dr.-Ing. Peter Elsner
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Materials and Structures for High Performance Systems (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of each Major Field at least 8 ECTS have to be chosen.

Election block: Polymerengineering (K) (at least 8 credits)			
T-MACH-102137	Polymer Engineering I	4 CR	Elsner
T-MACH-102138	Polymer Engineering II	4 CR	Elsner
Election block: Polymerengineering (E) (at most 8 credits)			
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	4 CR	Henning
T-MACH-105330	Design with Plastics	4 CR	Liedel
T-MACH-105333	Mechanics and Strength of Polymers	4 CR	von Bernstorff
T-MACH-105971	Simulation of the process chain of continuously fiber reinforced composite structure	4 CR	Kärger
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger

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

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

Competence Goal
The students...

- are able to choose polymers for abblications in mechanical engineering in target-oriented way and are able to justify their selection.
- are able to describe and compare production processes for polymers and PMCs exemplarily.
- are able to describe the mechanical behaviour of polymers and PMC based on scientific theories, principles and methods.
- are able to solve tasks in the field of polymer engineering and proceed adequate to the situation.
- are able to integrate intra-modular knowledge at the solution of given problems.
- have the ability to develop polymer parts in a constructive way under consideration of technical and economic conditions.

Prerequisites
None

Content
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.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.47 Module: Major Field: Power Plant Technology (SP 23) [M-MACH-102610]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Kraftwerkstechnik (K) (at least 8 credits)			
T-MACH-105410	Coal Fired Power Plants	4 CR	Schulenberg
T-MACH-105444	Combined Cycle Power Plants	4 CR	Schulenberg
T-MACH-105326	Hydraulic Fluid Machinery	8 CR	Pritz
T-MACH-105402	Nuclear Power Plant Technology	4 CR	Badea, Cheng, Schulenberg
T-MACH-105363	Thermal Turbomachines I	6 CR	Bauer
T-MACH-105364	Thermal Turbomachines II	6 CR	Bauer
Election block: Kraftwerkstechnik (E) (at most 5 credits)			
T-MACH-105310	Design of Highly Stresses Components	4 CR	Aktaa
T-MACH-105525	Introduction to Nuclear Energy	4 CR	Cheng
T-MACH-105952	Energy Storage and Network Integration	4 CR	Jäger, Stieglitz
T-MACH-105411	Fusion Technology A	4 CR	Stieglitz
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas, Sommerer
T-MACH-105386	Occupational Safety and Environmental Protection	4 CR	von Kiparski
T-MACH-105404	Innovative Nuclear Systems	4 CR	Cheng
T-MACH-105414	Cooling of Thermally High Loaded Gas Turbine Components	4 CR	Bauer, Schulz
T-MACH-105338	Numerical Fluid Mechanics	4 CR	Magagnato
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-MACH-107447	Reliability Engineering 1	3 CR	Konnov
T-MACH-105354	Fatigue of Metallic Materials	4 CR	Guth, Lang
T-MACH-105445	Simulator Exercises Combined Cycle Power Plants	2 CR	Schulenberg
T-MACH-105225	Thermal Solar Energy	4 CR	Stieglitz
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-105365	Turbine and Compressor Design	4 CR	Bauer
T-MACH-105416	Hydrogen Technologies	4 CR	Jordan
T-MACH-105234	Windpower	4 CR	Lewald
T-MACH-105406	Two-Phase Flow and Heat Transfer	4 CR	Schulenberg, Wörner
Election block: Kraftwerkstechnik (P) (at most 4 credits)			
T-MACH-105515	Introduction to Numerical Fluid Dynamics	4 CR	Pritz
T-MACH-105331	Laboratory Exercise in Energy Technology	4 CR	Bauer, Maas, Wirbser
T-MACH-106707	Workshop on computer-based flow measurement techniques	4 CR	Bauer

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After completion of SP 23 students are able:

- to name the different types of centralized and distributed power plants,
- to explain the operational principle of well-established power plants as well as of power plants based on renewable energies.
- to predict the electric, respectively thermal efficiency of power plants,
- to assess the economics of power plants,
- to highlight the environmental impact of conventional power plants and of renewable energies,
- to assess the availability, operational safety and flexibility of different types of power plants,
- to develop advanced power plants based on thermodynamic, fluid mechanical and other basics.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, tutorials.

10.48 Module: Major Field: Powertrain Systems (SP 02) [M-MACH-102599]

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

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of each Major Field at least 8 ECTS have to be chosen.

Election block: Antriebssysteme (K) (at least 8 credits)			
T-MACH-105307	Drive Train of Mobile Machines	4 CR	Geimer, Wydra
T-MACH-105233	Powertrain Systems Technology A: Automotive Systems	4 CR	Albers, Matthiesen, Ott
T-MACH-105216	Powertrain Systems Technology B: Stationary Machinery	4 CR	Albers, Matthiesen, Ott
T-MACH-105226	Dynamics of the Automotive Drive Train	5 CR	Fidlin
Election block: Antriebssysteme (E) (at most 8 credits)			
T-MACH-105215	Applied Tribology in Industrial Product Development	4 CR	Albers, Lorentz, Matthiesen
T-MACH-105536	Dimensioning and Optimization of Power Train System	4 CR	Albers, Faust, Kirchner, Matthiesen
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Braun, Schönung
T-ETIT-100784	Hybrid and Electric Vehicles	4 CR	Becker
T-MACH-105187	IT-Fundamentals of Logistics	3 CR	Thomas
T-MACH-105231	Leadership and Management Development	4 CR	Albers, Matthiesen, Ploch
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Ays, Geerling
T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-105696	Strategic product development - identification of potentials of innovative products	3 CR	Albers, Matthiesen, Siebe
T-MACH-110396	Strategic product development - identification of potentials of innovative products - Case Study	1 CR	Albers, Matthiesen, Siebe
T-MACH-105358	Sustainable Product Engineering	4 CR	Albers, Matthiesen, Ziegahn
T-MACH-105531	Tribology	8 CR	Dienwiebel, Scherge
T-MACH-102194	Combustion Engines I	4 CR	Koch, Kubach
T-MACH-102140	Failure of Structural Materials: Deformation and Fracture	4 CR	Gumbsch, Weygand

Election block: Antriebssysteme (Ü) ()			
T-MACH-109303	Exercices - Tribology	0 CR	Dienwiebel

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students know and understand the technical and physical basics and systematic connections of drive systems. The lecture deals vehicle drive systems as well as drive systems for stationary and mobile work machines.

They are able to choose, describe and use complex dimensioning- and design methods for drive systems under consideration of the interactions of the system.

Prerequisites
none

Content
See brick courses

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

10.49 Module: Major Field: Production Technology (SP 39) [M-MACH-102618]

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

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt (p))

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	3

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Produktionstechnik (K) (at least 8 credits)			
T-MACH-108844	Automated Manufacturing Systems	8 CR	Fleischer
T-MACH-102105	Manufacturing Technology	8 CR	Schulze, Zanger
T-MACH-110337	Global Production and Logistics	8 CR	Furmans, Lanza
T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0	8 CR	Lanza
T-MACH-109055	Machine Tools and Industrial Handling	8 CR	Fleischer
Election block: Produktionstechnik (E) (at most 8 credits)			
T-MACH-110176	Digitalization from Production to the Customer in the Optical Industry	4 CR	Wawerla
T-MACH-102159	Elements and Systems of Technical Logistics	4 CR	Fischer, Mittwollen
T-MACH-108946	Elements and Systems of Technical Logistics - Project	2 CR	Fischer, Mittwollen
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Braun, Schönung
T-MACH-105157	Foundry Technology	4 CR	Wilhelm
T-MACH-105158	Global Production and Logistics - Part 1: Global Production	4 CR	Lanza
T-MACH-105159	Global Production and Logistics - Part 2: Global Logistics	4 CR	Furmans
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-106374	Human-oriented Productivity Management: Personnel Management	4 CR	Stock
T-MACH-105388	Introduction to Industrial Production Economics	4 CR	Dürrschnabel
T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars	4 CR	Schlichtenmayer
T-MACH-110334	International Production Engineering A	4 CR	Fleischer
T-MACH-110335	International Production Engineering B	4 CR	Fleischer
T-MACH-105174	Warehousing and Distribution Systems	3 CR	Furmans
T-MACH-105231	Leadership and Management Development	4 CR	Albers, Matthiesen, Ploch
T-MACH-105783	Learning Factory “Global Production“	4 CR	Lanza
T-MACH-105165	Automotive Logistics	4 CR	Furmans
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-105387	Planning of Assembly Systems	4 CR	Haller
T-MACH-105340	PLM in the Manufacturing Industry	4 CR	Ovtcharova
T-MACH-110318	Product- and Production-Concepts for modern Automobiles	4 CR	Kienzle, Steegmüller
T-MACH-105470	Production Planning and Control	4 CR	Rinn
T-MACH-105523	Productivity Management in Production Systems	4 CR	Stowasser

T-MACH-105457	Project Mikromanufacturing: Development and Manufacturing of Microsystems	5 CR	Schulze
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Ays, Geerling
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-105170	Welding Technology	4 CR	Farajian
T-MACH-108737	Seminar Data-Mining in Production	3 CR	Lanza
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-105362	Technology of Steel Components	4 CR	Schulze
T-MACH-105177	Metal Forming	4 CR	Herlan
T-MACH-102148	Gear Cutting Technology	4 CR	Klaiber
Election block: Produktionstechnik (P) (at most 4 credits)			
T-MACH-102099	Experimental Lab Class in Welding Technology, in Groups	4 CR	Dietrich
T-MACH-102154	Laboratory Laser Materials Processing	4 CR	Schneider
T-MACH-108878	Laboratory Production Metrology	4 CR	Häfner
T-MACH-105346	Production Techniques Laboratory	4 CR	Deml, Fleischer, Furmans, Ovtcharova

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

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

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

Competence Goal
The students ...

- are able to analyze new situations and choose methods of production science target-oriented based on the analyses, as well as justifying their selection.
- are able to describe and compare complex production processes exemplarily.
- are able to generate new solutions in the field of production science under consideration of scientific theories, principles and methods.
- are able to solve tasks in the field of production science team oriented and proceed responsible and adequate to the situation.
- are able to integrate the results of others at the solution of given problems.
- have the ability to state results in written form developed in a team, and are able to interpret and present them with self-chosen methods.
- are able to identify, dissect and develop further systems and processes and apply given sets of criteria under consideration of technical, economic and social conditions.

Prerequisites
None

Content
Within this module the students will get to know and learn about production science. Manifold lectures and excursions as part of several lectures provide specific insights into the field of production science.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, seminars, workshops, excursions

10.50 Module: Major Field: Rail System Technology (SP 50) [M-MACH-102641]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Vehicle Technology (Schwerpunkt (p))
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-106424	Rail System Technology	4 CR	Gratzfeld
T-MACH-105353	Rail Vehicle Technology	4 CR	Gratzfeld
Election block: Bahnsystemtechnik (E) (at most 10 credits)			
T-MACH-105540	Railways in the Transportation Market	4 CR	Gratzfeld
T-MACH-102121	Electric Rail Vehicles	4 CR	Gratzfeld
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	4 CR	Henning
T-MACH-104599	Project Management in Rail Industry	4 CR	Gratzfeld
T-MACH-105350	Computational Vehicle Dynamics	4 CR	Proppe
T-MACH-108692	Seminar for Rail System Technology	3 CR	Gratzfeld

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

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

Competence Goal

- The students understand relations and interdependencies between rail vehicles, infrastructure and operation in a rail system.
- Based on operating requirements and legal framework they derive the requirements concerning a capable infrastructure and suitable concepts of rail vehicles.
- They recognize the impact of alignment, understand the important function of the wheel-rail-contact and estimate the impact of driving dynamics on the operating program.
- They evaluate the impact of operating concepts on safety and capacity of a rail system.
- They know the infrastructure to provide power supply to rail vehicles with different drive systems.
- The students learn the role of rail vehicles and understand their classification. They understand the basic structure und know the functions of the main systems. They understand the overall tasks of vehicle system technology.
- They learn functions and requirements of car bodies and jugde advantages and disadvantages of design principles. They know the functions of the car body's interfaces.
- They know about the basics of running dynamics and bogies.
- The students learn about advantages and disadvantages of different types of traction drives and judge, which one fits best for each application.
- They understand brakes from a vehicular and an operational point of view. They assess the fitness of different brake systems.
- They know the basic setup of train control management system and understand the most important functions.
- They specify and define suitable vehicle concepts based on requirements for modern rail vehicles.
- Supplementary lectures present further major aspects of a rail system.

Prerequisites
None

Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, power networks, filling stations
8. Vehicle system technology: structure and main systems of rail vehicles
9. Car body: functions, requirements, design principles, crash elements, interfaces
10. Bogies: forces, running gears, axle configuration
11. Drives: vehicle with/without contact wire, dual-mode vehicle
12. Brakes: tasks, basics, principles, blending, brake control
13. Train control management system: definitions, networks, bus systems, components, examples
14. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck coaches, locomotives, freight wagons
15. History (optional)
16. Further contents in supplementary lectures

Annotation
A bibliography is available for download (Ilias-platform).

Workload

- Total effort at 16 ECTS (M.Sc.): about 480 hours
- Regular attendance: 84 hours
- Self-study: 84 hours
- Exam and preparation: 312 hours

Learning type
Lectures in the core part.

Lectures and seminars are offered in the supplementary part.

10.51 Module: Major Field: Reliability in Mechanical Engineering (SP 49) [M-MACH-102602]

Responsible: Prof. Dr. Peter Gumbsch
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)
Specialization / Specialization: Materials and Structures for High Performance Systems (Schwerpunkt (p))

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-102139	Failure of Structural Materials: Fatigue and Creep	4 CR	Gruber, Gumbsch
T-MACH-102140	Failure of Structural Materials: Deformation and Fracture	4 CR	Gumbsch, Weygand
Election block: Zuverlässigkeit im Maschinenbau (E) ()			
T-MACH-105390	Application of Advanced Programming Languages in Mechanical Engineering	4 CR	Weygand
T-MACH-105308	Atomistic Simulations and Molecular Dynamics	4 CR	Brandl, Gumbsch, Schneider
T-MACH-105310	Design of Highly Stresses Components	4 CR	Aktaa
T-MACH-105320	Introduction to the Finite Element Method	4 CR	Böhlke, Langhoff
T-MACH-105321	Introduction to Theory of Materials	4 CR	Kamlah
T-MACH-105984	Fatigue of Welded Components and Structures	3 CR	Farajian, Gumbsch
T-MACH-105324	Foundations of Nonlinear Continuum Mechanics	4 CR	Kamlah
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
T-MACH-105334	Mechanics in Microtechnology	4 CR	Greiner, Gruber
T-MACH-105303	Modelling of Microstructures	5 CR	August, Nestler
T-MACH-105516	Multi-Scale Plasticity	4 CR	Greiner, Schulz
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-105724	Failure Analysis	4 CR	Greiner, Schneider
T-MACH-105354	Fatigue of Metallic Materials	4 CR	Guth, Lang
T-MACH-105171	Safety Engineering	4 CR	Kany
T-MACH-105369	Materials Modelling: Dislocation Based Plasticy	4 CR	Weygand
T-MACH-100532	Scientific Computing for Engineers	5 CR	Gumbsch, Weygand
T-MACH-110375	Mathematical Methods in Continuum Mechanics	4 CR	Böhlke
T-MACH-110377	Advanced Methods in Strength of Materials	4 CR	Böhlke, Frohnapfel
T-MACH-110378	Mathematical Methods in Micromechanics	5 CR	Böhlke
Election block: Zuverlässigkeit im Maschinenbau (P) (at most 4 credits)			
T-MACH-105392	FEM Workshop - Constitutive Laws	4 CR	Schulz, Weygand
T-MACH-105417	Finite Element Workshop	4 CR	Mattheck, Weygand
Election block: Zuverlässigkeit im Maschinenbau (Ü) ()			
T-MACH-109304	Excercises - Fatigue of Welded Components and Structures	1 CR	Farajian, Gumbsch

T-MACH-110333	Tutorial Continuum Mechanics of solids and fluids	1 CR	Böhlke, Frohnapfel
T-MACH-110376	Tutorial Mathematical Methods in Continuum Mechanics	1 CR	Böhlke
T-MACH-110379	Tutorial Mathematical Methods in Micromechanics	1 CR	Böhlke

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

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

Competence Goal
After attending the core subjects "failure of structural materials: fatigue and creep" (T-MACH-102139) and "failure of structural materials: deformation and fracture"(T-MACH-102140) the students will gain the following skills:

- They have the basic understanding of mechanical processes to explain the relationship between externally applied load and materials strength.
- They can explain the foundation of linear elastic fracture mechanics and is able to determine if this concept can be applied to a failure by fracture.
- They can decribe the main empirical materials models for fatigue and creep as well as for deformation and fracture and can apply them.
- They have the physical understanding to describe and explain phenomena of failure.
- They can use statistical approaches for reliability predictions.
- They can use its acquired skills, to select and develop materials for specific applications.

The additional learning outcomes depend on which further lectures are selected and are explicitly described there.

Prerequisites
None

Content
In addition to the core subjects "failure of structural materials: fatigue and creep" (T-MACH-102139) and "failure of structural materials: deformation and fracture" (T-MACH-102140), the student has to choose two more lectures, which deal with specific problems of reliability of components and systems in mechanical engineering.

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

Recommendation
preliminary knowlegde in mathematics, mechanics and materials science

Annotation
The module Reliability in Mechanical Engineering consists of 16 credit points in the master´s program. Within that module, the students have to pass bricks T-MACH-105531 and T-MACH-109303 from the core area (8 credit points) and can select from a broad variation of courses within the supplementary area.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
In the core area of the major field Materials Science and Engineering the students have to pass bricks T-MACH-102139 and T-MACH-102140 (obligatory).

Within the supplementary area students can choose not only lectures and tutorials but also lab courses and seminars.

M 10.52 Module: Major Field: Robotics (SP 40) [M-MACH-102633]

Responsible: Prof. Dr. Ralf Mikut
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt (p))
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Robotik (K) (at least 8 credits)			
T-MACH-105314	Computational Intelligence	4 CR	Jakob, Mikut, Reischl
T-MACH-105694	Data Analytics for Engineers	5 CR	Ludwig, Mikut, Reischl
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-INFO-108014	Robotics I - Introduction to Robotics	6 CR	Asfour
T-INFO-105723	Robotics II: Humanoid Robotics	3 CR	Asfour
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
Election block: Robotik (E) (at most 8 credits)			
T-MACH-105216	Powertrain Systems Technology B: Stationary Machinery	4 CR	Albers, Matthiesen, Ott
T-MACH-108844	Automated Manufacturing Systems	8 CR	Fleischer
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-105378	Cognitive Automobiles - Laboratory	6 CR	Kitt, Lauer, Stiller
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
T-INFO-101377	Localization of Mobile Agents	6 CR	Hanebeck
T-MACH-105223	Machine Vision	8 CR	Lauer, Stiller
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MACH-105335	Measurement II	4 CR	Stiller
T-MACH-108809	Micro- and nanosystem integration for medical, fluidic and optical applications	4 CR	Gengenbach, Hagenmeyer, Koker, Sieber
T-MACH-105539	Modern Control Concepts I	4 CR	Groell, Matthes
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-105384	Computerized Multibody Dynamics	4 CR	Seemann
T-INFO-101352	Robotics III - Sensors in Robotics	3 CR	Asfour
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-105358	Sustainable Product Engineering	4 CR	Albers, Matthiesen, Ziegahn
T-MACH-105555	System Integration in Micro- and Nanotechnology	4 CR	Gengenbach
T-MACH-105360	Computer Engineering	6 CR	Keller, Lorch
Election block: Robotik (P) (at most 4 credits)			

T-INFO-105142	Humanoid Robots - Practical Course	3 CR	Asfour
T-MACH-105370	Laboratory Mechatronics	4 CR	Lorch, Seemann, Stiller
T-MACH-108878	Laboratory Production Metrology	4 CR	Häfner
T-MACH-105341	Lab Computer-Aided Methods for Measurement and Control	4 CR	Stiller
T-MACH-102149	Virtual Reality Practical Course	4 CR	Ovtcharova

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The Robotics offers extensive knowledge to develop, design and manufacture future intelligent robots. The following scientific disciplines are covered during the major Robotics:

- Control systems and control theory
- Actuators and sensors
- Mathematical and descriptive methods

The students of the major Robotics have the essential skills necessary to develop future robotic systems for modern applications.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lecture, tutorial.

10.53 Module: Major Field: Technical Ceramics and Powder Materials (SP 43) [M-MACH-102619]

Responsible: Prof. Dr. Michael Hoffmann
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Materials and Structures for High Performance Systems (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Technische Keramik und Pulverwerkstoffe (K) (at least 8 credits)			
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	4 CR	Schell
T-MACH-100287	Introduction to Ceramics	6 CR	Hoffmann
T-MACH-106722	Ceramic Matrix Composites	4 CR	Koch
T-MACH-102179	Structural Ceramics	4 CR	Hoffmann
Election block: Technische Keramik und Pulverwerkstoffe (E) (at most 8 credits)			
T-MACH-106723	Bionic Inspired Reinforced Composites	4 CR	Koch
T-MACH-102182	Ceramic Processing Technology	4 CR	Binder
T-MACH-102157	High Performance Powder Metallurgy Materials	4 CR	Schell
T-MACH-102170	Structural and Phase Analysis	4 CR	Wagner
T-MACH-102140	Failure of Structural Materials: Deformation and Fracture	4 CR	Gumbsch, Weygand
Election block: Technische Keramik und Pulverwerkstoffe (P) (at most 4 credits)			
T-MACH-105178	Practical Course Technical Ceramics	1 CR	Schell

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students acquire comprehensive and fundamental knowledge of preparation, processing and characterization of technical powders, their consolidation by various shaping techiques and the densification by sintering. They know the manifold possibilities of microstructural design of powdermetallurgical parts and are able to discuss the microstructure property relationships.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.54 Module: Major Field: Technical Logistics (SP 44) [M-MACH-102640]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	2

Mandatory			
T-MACH-109919	Basics of Technical Logistics I	4 CR	Mittwollen, Oellerich
T-MACH-109920	Basics of Technical Logistics II	5 CR	
Election block: Technische Logistik (E) (at least 7 credits)			
T-MACH-102160	Selected Applications of Technical Logistics	4 CR	Milushev, Mittwollen
T-MACH-108945	Selected Applications of Technical Logistics - Project	2 CR	Milushev, Mittwollen
T-MACH-108844	Automated Manufacturing Systems	8 CR	Fleischer
T-MACH-102159	Elements and Systems of Technical Logistics	4 CR	Fischer, Mittwollen
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Braun, Schönung
T-MACH-105159	Global Production and Logistics - Part 2: Global Logistics	4 CR	Furmans
T-MACH-105187	IT-Fundamentals of Logistics	3 CR	Thomas
T-MACH-105378	Cognitive Automobiles - Laboratory	6 CR	Kitt, Lauer, Stiller
T-MACH-105175	Airport Logistics	3 CR	Richter
T-MACH-105174	Warehousing and Distribution Systems	3 CR	Furmans
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-105171	Safety Engineering	4 CR	Kany
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling

Competence Certificate
see brick courses

Competence Goal
Students are able to:

- Describe main functional elements of of technical logistics,
- Determine the main parameters necessary for functionality,
- Combines those functional elements to solve material handling tasks appropriate, and
- Evalute resulting material handling installations.

Prerequisites
None

Content
The emphasis module *Technical Logistics* provides in-depth basics on the main topics of technical logistics. The module focuses on technical characteristics of material handling technology. To gain a deeper understanding, the course is accompanied by exercises.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures and practices; self-study

10.55 Module: Major Field: Thermal Turbomachines (SP 46) [M-MACH-102636]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)
Specialization / Specialization: Materials and Structures for High Performance Systems (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-105363	Thermal Turbomachines I	6 CR	Bauer
T-MACH-105364	Thermal Turbomachines II	6 CR	Bauer
Election block: Thermische Turbomaschinen (E) ()			
T-MACH-105310	Design of Highly Stresses Components	4 CR	Aktaa
T-MACH-105512	Experimental Fluid Mechanics	4 CR	Kriegseis
T-MACH-105444	Combined Cycle Power Plants	4 CR	Schulenberg
T-MACH-105533	Gasdynamics	4 CR	Magagnato
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
T-MACH-105414	Cooling of Thermally High Loaded Gas Turbine Components	4 CR	Bauer, Schulz
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	4 CR	Koch
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-107447	Reliability Engineering 1	3 CR	Konnov
T-MACH-105354	Fatigue of Metallic Materials	4 CR	Guth, Lang
T-MACH-105171	Safety Engineering	4 CR	Kany
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MACH-105365	Turbine and Compressor Design	4 CR	Bauer
T-MACH-105366	Turbo Jet Engines	4 CR	Bauer
T-MACH-102139	Failure of Structural Materials: Fatigue and Creep	4 CR	Gruber, Gumbsch
T-MACH-102140	Failure of Structural Materials: Deformation and Fracture	4 CR	Gumbsch, Weygand
T-MACH-105784	Vortex Dynamics	4 CR	Kriegseis
Election block: Thermische Turbomaschinen (P) (at most 4 credits)			
T-MACH-106707	Workshop on computer-based flow measurement techniques	4 CR	Bauer
T-MACH-105445	Simulator Exercises Combined Cycle Power Plants	2 CR	Schulenberg

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
After completion of SP 46 students are able to:

- identify and quantify the specific requirements of different applications in the fields of energy technology, aeronautics, car and motor technology and process technology on thermal turbo machines,
- apply the basics of thermodynamics, fluid mechanics and of other generic disciplines to analyse and design turbo machines and their components,
- explain the governing processes in turbo machines such as compression, combustion and expansion,
- Recognise and exploit the potentials to further improve the economics and environmental friendliness of turbo machines, their components and in their interaction with the overarching systems, like power plant or airplane,
- Explain the operational principle of turbo machines and the related generics.

Prerequisites
None

Content
Thermal turbo machines are driving generators of power plants to generate electric energy. In aeronautics turbofan, turboprop and turboshaft engines are the dominating propulsion systems for airplanes and helicopters due to their high specific power-to-weight ratio and efficiency. Turbochargers are providing increased power and efficiency to internal combustion engines. Turbocompressors are used in multiple applications in chemical and process industry. In the major subject “Thermal Turbo Machines” students learn to apply their basic knowledge in thermodynamics, fluid mechanics, technical mechanics and other generic disciplines to analyse and develop challenging applications.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.56 Module: Major Field: Tribology (SP 47) [M-MACH-102637]

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

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)
Specialization / Specialization: Materials and Structures for High Performance Systems (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Mandatory			
T-MACH-105531	Tribology	8 CR	Dienwiebel, Scherge
T-MACH-109303	Exercices - Tribology	0 CR	Dienwiebel
Election block: Tribologie (E) ()			
T-MACH-105215	Applied Tribology in Industrial Product Development	4 CR	Albers, Lorentz, Matthiesen
T-MACH-105233	Powertrain Systems Technology A: Automotive Systems	4 CR	Albers, Matthiesen, Ott
T-MACH-105308	Atomistic Simulations and Molecular Dynamics	4 CR	Brandl, Gumbsch, Schneider
T-MACH-102141	Constitution and Properties of Wearresistant Materials	4 CR	Ulrich
T-MACH-105786	Contact Mechanics	4 CR	Greiner
T-MACH-105180	Nanotechnology for Engineers and Natural Scientists	4 CR	Dienwiebel, Hölscher, Walheim
T-MACH-102167	Nanotribology and -Mechanics	4 CR	Dienwiebel, Hölscher
T-MACH-102137	Polymer Engineering I	4 CR	Elsner
T-MACH-105724	Failure Analysis	4 CR	Greiner, Schneider
T-MACH-102103	Superhard Thin Film Materials	4 CR	Ulrich
Election block: Tribologie (P) (at most 4 credits)			
T-MACH-105813	Practical Course “Tribology”	4 CR	Dienwiebel, Schneider

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

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

Competence Goal
After attending the core subject "tribology" (2181114) the students have the following skills:

- They can describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems.
- They can evaluate the friction and wear behavior of tribological systems.
- They can explain the effects of lubricants and their most important additives.
- They can identify suitable approaches to optimize tribological systems.
- They 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.
- They can 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.
- The can describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces.

The additional learning outcomes depend on which further lectures are selected and are explicitly described there.

Prerequisites
None

Content
In addition to the core subject "tribology" (bricks T-MACH-105531 and T-MACH-109303), the student has to choose two more lectures, which deal with specific problems of tribology, e.g. in the field of product deveolpment, simulation or materials selection.

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

Annotation
The module Tribology consists of 16 credit points in the master´s program. Within that module, the students have to pass bricks T-MACH-105531 and T-MACH-109303 from the core area (8 credit points) and can select from a broad variation of courses within the supplementary area.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
In the core area of the major field Materials Science and Engineering the students have to pass bricks T-MACH-105531 and T-MACH-109303 (obligatory).

Within the supplementary area students can choose not only lectures and tutorials but also lab courses and seminars.

10.57 Module: Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics (SP 11) [M-MACH-102606]

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

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Fahrdynamik, Fahrzeugkomfort und -akustik (K) (at least 8 credits)			
T-MACH-105154	Vehicle Comfort and Acoustics I	4 CR	Gauterin
T-MACH-105155	Vehicle Comfort and Acoustics II	4 CR	Gauterin
Election block: Fahrdynamik, Fahrzeugkomfort und -akustik (E) (at most 11 credits)			
T-MACH-105233	Powertrain Systems Technology A: Automotive Systems	4 CR	Albers, Matthiesen, Ott
T-MACH-105226	Dynamics of the Automotive Drive Train	5 CR	Fidlin
T-MACH-105152	Handling Characteristics of Motor Vehicles I	4 CR	Unrau
T-MACH-105153	Handling Characteristics of Motor Vehicles II	4 CR	Unrau
T-MACH-108374	Vehicle Ergonomics	4 CR	Heine
T-MACH-105156	Vehicle Mechatronics I	4 CR	Ammon
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-102117	Automotive Engineering II	4 CR	Gauterin, Unrau
T-MACH-105375	Industrial Aerodynamics	4 CR	Breitling, Frohnapfel
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
T-MACH-105539	Modern Control Concepts I	4 CR	Groell, Matthes
T-MACH-105349	Computational Dynamics	4 CR	Proppe
T-MACH-105350	Computational Vehicle Dynamics	4 CR	Proppe
T-MACH-105384	Computerized Multibody Dynamics	4 CR	Seemann
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
T-MACH-105443	Wave Propagation	4 CR	Seemann

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The student

- knows and understands the dynamic characteristics of vehicles, owing to the construction and design tokens,
- knows and understands especially the factors being relevant for comfort and acoustics,
- is capable of fundamentally evaluating and rating handling characteristics.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, Tutorials

M 10.58 Module: Major Field: Vehicle Technology (SP 12) [M-MACH-102607]

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

Part of: Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Vehicle Technology (Schwerpunkt (p))
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)

Credits	Recurrence	Language	Level	Version
16	Once	German/English	4	4

Election notes
In the core area of Majo Field at least 8 ECTS have to be chosen.

Election block: Kraftfahrzeugtechnik (K) (at least 8 credits)			
T-MACH-100092	Automotive Engineering I	8 CR	Gauterin, Unrau
Election block: Kraftfahrzeugtechnik (E) (at most 8 credits)			
T-MACH-105655	Alternative Powertrain for Automobiles	4 CR	Noreikat
T-MACH-105233	Powertrain Systems Technology A: Automotive Systems	4 CR	Albers, Matthiesen, Ott
T-MACH-105536	Dimensioning and Optimization of Power Train System	4 CR	Albers, Faust, Kirchner, Matthiesen
T-MACH-108844	Automated Manufacturing Systems	8 CR	Fleischer
T-MACH-105226	Dynamics of the Automotive Drive Train	5 CR	Fidlin
T-MACH-105152	Handling Characteristics of Motor Vehicles I	4 CR	Unrau
T-MACH-105153	Handling Characteristics of Motor Vehicles II	4 CR	Unrau
T-MACH-108374	Vehicle Ergonomics	4 CR	Heine
T-MACH-105154	Vehicle Comfort and Acoustics I	4 CR	Gauterin
T-MACH-105155	Vehicle Comfort and Acoustics II	4 CR	Gauterin
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning
T-MACH-105156	Vehicle Mechatronics I	4 CR	Ammon
T-MACH-102207	Tires and Wheel Development for Passenger Cars	4 CR	Leister
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	4 CR	Henning
T-MACH-102117	Automotive Engineering II	4 CR	Gauterin, Unrau
T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment	4 CR	Deutschmann, Grunwaldt, Kubach, Lox
T-MACH-102116	Fundamentals for Design of Motor-Vehicle Bodies I	2 CR	Bardehle
T-MACH-102119	Fundamentals for Design of Motor-Vehicle Bodies II	2 CR	Bardehle
T-MACH-105160	Fundamentals in the Development of Commercial Vehicles I	2 CR	Zürn
T-MACH-105161	Fundamentals in the Development of Commercial Vehicles II	2 CR	Zürn
T-MACH-105162	Fundamentals of Automobile Development I	2 CR	Frech
T-MACH-105163	Fundamentals of Automobile Development II	2 CR	Frech
T-ETIT-100784	Hybrid and Electric Vehicles	4 CR	Becker
T-MACH-105375	Industrial Aerodynamics	4 CR	Breitling, Frohnapfel
T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars	4 CR	Schlichtenmayer
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt

T-MACH-105164	Laser in Automotive Engineering	4 CR	Schneider
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-102155	Product, Process and Resource Integration in the Automotive Industry	4 CR	Mbang
T-MACH-102156	Project Workshop: Automotive Engineering	6 CR	Frey, Gauterin, Gießler
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Ays, Geerling
T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-MACH-105350	Computational Vehicle Dynamics	4 CR	Proppe
T-MACH-105696	Strategic product development - identification of potentials of innovative products	3 CR	Albers, Matthiesen, Siebe
T-MACH-105358	Sustainable Product Engineering	4 CR	Albers, Matthiesen, Ziegahn
T-MACH-102194	Combustion Engines I	4 CR	Koch, Kubach
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
T-MACH-102148	Gear Cutting Technology	4 CR	Klaiber
T-MACH-110318	Product- and Production-Concepts for modern Automobiles	4 CR	Kienzle, Steegmüller
T-MACH-110396	Strategic product development - identification of potentials of innovative products - Case Study	1 CR	Albers, Matthiesen, Siebe

Competence Certificate
Oral exams: duration approx. 5 min. per credit point. However, amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The student

- knows the most important components of a vehicle,
- knows and understands the functioning and the interaction of the individual components,
- knows the basics of dimensioning the components,
- knows and understands the procedures in automobile development,
- knows and understands the technical specifications at the development procedures,
- is aware of notable boundaries like legislation,
- is ready to analyze and judge vehicle concepts and to participate competently in the development of vehicles.

Prerequisites
None

Content
See brick courses.

Workload
The work load is about 480 hours, corresponding to 16 credit points.

Learning type
Lectures, tutorials.

10.59 Module: Major Field: Vibration Theory (SP 60) [M-MACH-104443]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of:
Specialization / Specialization: General Mechanical Engineering (Schwerpunkte)
Specialization / Specialization: Energy- and Environment Engineering (Schwerpunkt)
Specialization / Specialization: Vehicle Technology (Schwerpunkt)
Specialization / Specialization: Mechatronics and Microsystems Technology (Schwerpunkt)
Specialization / Specialization: Product Development and Engineering Design (Schwerpunkt)
Specialization / Specialization: Production Technology (Schwerpunkt)
Specialization / Specialization: Theoretical Mechanical Engineering (Schwerpunkt (p))

Credits	Language	Level	Version
16	German/English	4	1

Election notes
In the core area of Major Field at least 8 ECTS have to be chosen.

Election block: Schwingungslehre (K) (at least 8 credits)			
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105372	Theory of Stability	6 CR	Fidlin
Election block: Schwingungslehre (E) (at most 9 credits)			
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-105443	Wave Propagation	4 CR	Seemann
T-MACH-105226	Dynamics of the Automotive Drive Train	5 CR	Fidlin
T-MACH-105514	Experimental Dynamics	5 CR	Fidlin
T-MACH-105439	Introduction to Nonlinear Vibrations	7 CR	Fidlin
T-MACH-105154	Vehicle Comfort and Acoustics I	4 CR	Gauterin
T-MACH-105155	Vehicle Comfort and Acoustics II	4 CR	Gauterin
T-MACH-105349	Computational Dynamics	4 CR	Proppe
T-MACH-105373	Practical Training in Measurement of Vibrations	4 CR	Fidlin

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

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

Competence Goal
The students know different methods which may be applied for the analysis of investigation of vibrations problems. They are able to treat one or multiple degrees of freedom systems as well as vibrating continua. The goal is to establish a chain from physical modeling via mathematical solution to an interpretation of the results. Based on the courses which are chosen the knowledge has emphasis on theoretical investigations, approximation methods or experimental methods and applications in automotive engineering.

Prerequisites
none

Workload
The work load is about 480 hours, corresponding to 16 credit points. 1 LP = 30 working hours

Learning type
Lectures, Tutorials

M 10.60 Module: Master's Thesis [M-MACH-102858]

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

Part of: Master Thesis

Credits	Language	Level	Version
30	German	4	1

Mandatory			
T-MACH-105299	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 six 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 master thesis is to be evaluated by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITGor habilitated members of the KIT Faculty 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.

The colloquium presentation must be held within 6 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.

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.

Prerequisites
The requirement for admission to the master thesis module are 74 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 earn at least 74 credits in the following fields:
    - Advanced Engineering Fundamentals
    - Specialization

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 10.61 Module: Mathematical Methods (MSc-Modul 08, MM) [M-MACH-102594]

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

Part of: Advanced Engineering Fundamentals

Credits	Recurrence	Language	Level	Version
6	Once	German/English	4	2

Election block: Mathematische Methoden (1 item)			
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105295	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MATH-102242	Numerical Mathematics for Students of Computer Science	6 CR	Rieder, Weiß, Wieners
T-MATH-109620	Probability Theory and Statistics	6 CR	Hug
T-MACH-110375	Mathematical Methods in Continuum Mechanics	4 CR	Böhlke
T-MACH-110378	Mathematical Methods in Micromechanics	5 CR	Böhlke
Election block: Übungen zu Mathematische Methoden ()			
T-MACH-110376	Tutorial Mathematical Methods in Continuum Mechanics	1 CR	Böhlke
T-MACH-110379	Tutorial Mathematical Methods in Micromechanics	1 CR	Böhlke

Competence Certificate
written exam, duration 3 h

Competence Goal
Students will deepen and explain mathematical methods and transfer them to a variety of engineering problems. They are able to select suitable methods and transfer them to new problems.

Prerequisites
none

Content
see chosen brick course.

Workload
The work load is about 180 hours, corresponding to 6 credit points.

Learning type
Lectures, Tutorials

M 10.62 Module: Modeling and Simulation (MSc-Modul 05, MS) [M-MACH-102592]

Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Marcus Geimer
Dr. Balazs Pritz
Prof. Dr.-Ing. Carsten Proppe

Organisation: KIT Department of Mechanical Engineering

Part of: Advanced Engineering Fundamentals

Credits	Recurrence	Language	Level	Version
7	Once	German/English	4	1

Mandatory			
T-MACH-105297	Modeling and Simulation	7 CR	Furmans, Geimer, Pritz, Proppe

Competence Certificate
written exam, 3 hours

Competence Goal
Students are able to explain models and simulations as part of many disciplines of mechanical engineering. They are able to reproduce the interdisciplinary aspects of typical modeling and simulation techniques in mechanical engineering. The students are proficient in simulation studies from problem formulation to modeling, simulation, verification and validation, ie:

- They are able to formulate the steps necessary to resolve problems arising in engineering, to create appropriate conceptual and mathematical models and to analyze them.

- They are able to develop and implement algorithms for the solution of mathematical models.

- They are able to perform comprehensive and interdisciplinary simulation studies to assess the simulation results and to critically evaluate the quality of the simulation results.

Prerequisites
none

Content
Introduction: Overview, concept formulation, simulation studies.

Time/event-discrete models, event-orientated/process orientated/transaction orientated view, typical model classes (operation/maintenance, storekeeping, loss-susceptible systems).

Time-continuous models with concentrated parameters, model characteristics and model analysis , numerical treatment of ordinary differential equations and differential-algebraic sets of equations. Coupled simulations with concentrated parameters.

Time-continuous models with distributed parameters, description of systems by means of partial differential equations, model reduction, numerical solution procedures for partial differential equations.

Workload
Regular attendance: 42 hours

Self-study: 168 hours

Learning type
Lecture and Tutorials

10.63 Module: Product Development - Dimensioning of Components (MSc-Modul 06, PE-B) [M-MACH-102593]

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

Part of: Advanced Engineering Fundamentals

Credits	Recurrence	Language	Level	Version
7	Once	German/English	4	1

Mandatory			
T-MACH-105383	Product Development - Dimensioning of Components	7 CR	Dietrich, Schulze

Competence Certificate
The assessment is carried out as a written exam (2 hours).

Competence Goal
The students...

- are capable to design and dimension components according to their load.
- can include mechanical material properties from the mechanical material test in the dimensioning process.
- can identify superimposed total loads and critical loads on simple components and to compute them.
- acquire the skill to select materials based on the application area of the components and respective loads.

Prerequisites
none

Content
The aim of the lecture is to present the topics of the dimensioning and the material science in their connection and to learn how to deal with corresponding methods and the combination thereof.
For the prospective engineer the most important educational objective is to understand the interaction of these topics while the interplay of the individual material stresses in the component are clarified.

The topics in detail are

- Structural dimensioning: basic stresses, superimposed stresses, notch influence, fatigue limit, fatigue strength, assessment of cracked components, operational strength, residual stresses, high temperature stress and corrosion
- Material selection: Basics, material indices, material selection diagrams, Ashby procedure, multiple boundary conditions, target conflicts, shape and efficiency.

Workload
The workload for the lecture “Product Development - Dimensioning of Components” is 210 h per semester and consists of the presence during the lectures (50 h) including tutorials, preparation and rework time at home (80 h) and preparation time for the oral exam (80 h).

Learning type
Lectures
Tutorials

10.64 Module: Product Development - Methods of Product Development [M-MACH-102718]

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

Organisation: KIT Department of Mechanical Engineering

Part of: Advanced Engineering Fundamentals

Credits	Language	Level	Version
6	German/English	4	2

Mandatory			
T-MACH-109192	Methods and Processes of PGE - Product Generation Development	6 CR	Albers, Burkardt, Matthiesen

Competence Certificate
Written examination (processing time: 120 min + 10 min reading time)

Competence Goal
The students are able to ...

- classify product development in companies and differentiate between different types of product development.
- name the relevant influencing factors of a market for product development.
- name, compare and use the central methods and process models of product development within moderate complex technical systems.
- explain problem solving techniques and associated development methods.
- explain product profiles and to differentiate and choose suitable creative techniques of solution/idea generation finding on this basis.
- use design guidelines to create simple technical systems and to explain these guidelines.
- name and compare quality assurance methods; to choose and use suitable methods for particular applications.
- explain the differents methods of design of experiment.
- explain the costs in development process.

Prerequisites
None

Content
Basics of Product Development: Basic Terms, Classification of the Product
Development into the industrial environment, generation of costs / responsibility for costs
Concept Development: List of demands / Abstraction of the Problem Definition / Creativity Techniques / Evaluation and selection of solutions
Drafting : Prevailing basic rules of Design / Design Principles as a
problem oriented accessory
Rationalization within the Product Development: Basics of Development
Management/ Simultaneous Engineering and Integrated Product Development/Development of Product
Lines and Modular Construction Systems
Quality Assurance in early Development Phases : Methods of Quality Assurance
in an overview/QFD/FMEA

Workload
regular attendance: 31.5 h

self-study: 148.5 h

Learning type
Lecture

Tutorial

Literature
Lecture documents
Pahl, Beitz: Konstruktionslehre, Springer-Verlag 1997
Hering, Triemel, Blank: Qualitätssicherung für Ingenieure; VDI-Verlag, 1993

11 Courses

T 11.1 Course: A holistic approach to power plant management [T-MACH-106698]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

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

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Annotation
none

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

V A holistic approach to power plant management

2189404, WS 19/20, 2 SWS, Language: English, Open in study portal — **Lecture (V)**

Description
Main Contents:

The structure ofelectricity markets

Requirements from network operators

The basics of commodity markets

The impact of regulation on power plant operation

The role of behavioral economics in power plant decision making

Integration of renewable energy sources into the electricity market

Calibration of power plant operation and maintenance to market requirements

Asset management for power plant fleets

Applying financial engineering to optimize asset utilization

Day-to-day decision making for power plant operation

Notes

Main Contents:

The structure ofelectricity markets

Requirements from network operators

The basics of commodity markets

The impact of regulation on power plant operation

The role of behavioral economics in power plant decision making

Integration of renewable energy sources into the electricity market

Calibration of power plant operation and maintenance to market requirements

Asset management for power plant fleets

Applying financial engineering to optimize asset utilization

Day-to-day decision making for power plant operation

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

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

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

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

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

Oral exam of about 25 min.

Learning Content

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

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

Workload

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

Literature

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

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

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

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

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

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

Competence Certificate
oral exam

Prerequisites
none

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

Actuators and sensors in nanotechnology

2141866, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

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

The lecture includes amongst others the following topics:

Nano technologies

Nano electro mechanical systems (NEMS)

Nano magneto mechanical and multiferroic systems

Polymer-based nano actuators

Nano motors, molecular systems

Adaptive nano optical systems

Nanosensors: concepts, materials, fabrication

Examples on different categories of materials and applications:

C-based, MeOx-based nano sensors

Physical, chemical, biological nano sensors

Multivariant data analysis / interpretation

Workload
time of attendance: 1.5 hours/week

Self-study: 8.5 hours/week

Literature

- Lecture notes
- 2. Balzani, V., Credi, A., & Venturi, M., Molecular devices and machines: concepts and perspectives for the nanoworld, 2008
- "Nanowires and Nanobelts, - Materials, Properties and Devices -, Volume 2: Nanowires and Nanobelts of Functional Materials", Edited by Zhong Lin Wang, Springer, 2003, ISBN 10 0-387-28706-X
- "Sensors Based on Nanostructured Materials", Edited by Francisco J. Arregui, Springer, 2009, ISBN: 978-0-387-77752-8
- "Multivariate Datenanalyse – Methodik und Anwendungen in der Chemie", R. Henrion, G. Henrion, Springer 1994, ISBN 3-540-58188-X

T 11.3 Course: Advanced Methods in Strength of Materials [T-MACH-110377]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Prof. Dr.-Ing. Bettina Frohnapfel

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Expansion	Version
Written examination	4	Each winter term	1 terms	1

Events					
WS 19/20	2161252	Continuum mechanics of solids and fluids	2 SWS	Lecture (V)	Böhlke, Frohnapfel

Competence Certificate
Written examination (90 min). Additives as announced

prerequisites to the exam: passing the corresponding Tutorial Continuum Mechanics of Solids and Fluids (T-MACH-110333)

Prerequisites
passing the corresponding Tutorial Continuum Mechanics of Solids and Fluids (T-MACH-110333)

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110333 - Tutorial Continuum Mechanics of solids and fluids must have been passed.

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

V Continuum mechanics of solids and fluids

Lecture (V)

2161252, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

- introduction into tensor calculus
- kinematics
- balance laws of mechanics and thermodynamics
- material theory of solids and fluids
- field equations for solids and fluids
- thermomechanical couplings
- dimensional analysis

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

Literature
lecture notes (in German)

Liu, I-S.: Continuum Mechanics. Springer, 2002.

Greve, R: Kontinuumsmechanik, Springer 2003

Joseph Spurk, J.; Aksel, N.: Strömungslehre, Springe 2010

Schade, H: Strömungslehre, de Gruyter 2013

T 11.4 Course: Aerodynamics [T-MACH-105528]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

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

Competence Certificate
oral exam 30 minutes

Prerequisites
none

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

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

Learning Content

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

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

See details at www.istm.kit.edu.

Workload
regular atendance: 20h

self studie: 100h

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

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

Schlichting, Gersten. Grenzschichttheorie, Springer

T 11.5 Course: Aerothermodynamics [T-MACH-105437]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Prof. Dr.-Ing. Friedrich Seiler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2154436	Aerothermodynamics	2 SWS		Seiler
Exams					
SS 2019	76-T-MACH-105437	Aerothermodynamics		Prüfung (PR)	Seiler

Competence Certificate
oral exam 30 minutes

Prerequisites
none

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

V Aerothermodynamics
2154436, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content

- Nature of a hypersonic flow
- Fundamentals of aerothermodynamics
- Problems during re-entry
- Flow regimes during re-entry
- Applied hypersonic research

Annotation
Block course with limited number of participants, registration in the secretary's office required. See details at www.istm.kit.edu

Workload
regular attendance: 21
self-study: 99h

Literature
H. Oertel jun.: Aerothermodynamik, Springer-Verlag, Berlin Heidelberg New York, 1994
F. Seiler: Skript zur Vorlesung über Aerothermodynamik

T 11.6 Course: Airport Logistics [T-MACH-105175]

Responsible: André Richter
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102625 - Major Field: Information Technology of Logistic Systems
M-MACH-102629 - Major Field: Logistics and Material Flow Theory
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Oral examination	3	Each winter term	2

Events					
WS 19/20	2117056	Airport logistics	2 SWS	Lecture (V)	Richter

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

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

V Airport logistics
2117056, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:
presentations

Notes

Media

Presentations

Learning content

- Introduction
- Airport installations
- Luggage transport
- Passenger transport
- Security on the airport
- Legal bases of the air traffic
- Freight on the airport

Learning goals

The students are able to:

- Describe material handling and informations technology activities on airports,
- Evaluate processes and systems on airports as the law stands, and
- Choose appropriate processes and material handling systems for airports.

Recommendations

None

Workload

Regular attendance: 21 hours
Self-study: 99 hours

Note

Limited number of participants: allocation of places in sequence of registration (first come first served). Registration via "ILIAS" mandatory.
Personal presence during lectures mandatory.

Learning Content

Introduction
airport installations
luggage transport
passenger transport
security on the airport
legal bases of the air traffic
freight on the airport

Annotation

Limited number of participants: allocation of places in sequence of application (first come first served)

Application via "ILIAS" mandatory

personal presence during lectures mandatory

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

„Gepäcklogistik auf Flughäfen“ à http://www.springer.com/de/book/9783642328527

T 11.7 Course: Alternative Powertrain for Automobiles [T-MACH-105655]

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

Part of: M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

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

Competence Certificate
written exam

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

V Alternative Powertrains for Automobiles

2133132, WS 19/20, 2 SWS, Open in study portal

Lecture (V)

Notes
History
Infrastructure
Market Situation
Legislation
Alternative Fuels
Innovative Drivetrains
Hybrids
Plug-In Hybrids
BEV
Fuel Cells

T 11.8 Course: Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines [T-MACH-105173]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

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

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

Prerequisites
none

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

V Analysis of Exhaust Gas und Lubricating Oil in Combustion Engines
Lecture (V)
2134150, SS 2019, 2 SWS, Language: German, Open in study portal

Description
Media:

Lecture with Powerpoint slides

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

Workload
regular attendance: 24 hrs

self study: 96 hrs

Literature
The lecture documents are distributed during the courses.

T 11.9 Course: Analysis Tools for Combustion Diagnostics [T-MACH-105167]

Responsible: Jürgen Pfeil
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102635 - Major Field: Engineering Thermodynamics
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

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

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

Prerequisites
none

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

V Analysis tools for combustion diagnostics

2134134, SS 2019, 2 SWS, Language: German, Open in study portal **Lecture (V)**

Learning Content
energy balance at the engine

energy conversion in the combustion chamber

thermodynamics of the combustion process

flow velocities

flame propagation

special measurement techniques

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

Literature
Lecture notes available in the lectures

T 11.10 Course: Appliance and Power Tool Design [T-MACH-105229]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

Type	Credits	Recurrence	Version
Oral examination	8	Each summer term	1

Events					
SS 2019	2145164	Appliance and Power Tool Design	3 SWS	Lecture (V)	Matthiesen
SS 2019	2145165	Appliance and Power Tool Design Project Work	1 SWS	Project (PRO)	Matthiesen, Mitarbeiter
Exams					
SS 2019	7600016	Appliance and Power Tool Design		Prüfung (PR)	Matthiesen
SS 2019	76-T-MACH-105229	Appliance and Power Tool Design		Prüfung (PR)	Matthiesen

Competence Certificate
Oral examination

Prerequisites
The participationin “ Appliance and power tool design”” requires the concurrent project work.
Due to organizational reasons, the number of participants is limited. At the beginning of august, a registration form will be available at the IPEK website. In the case of too many applicants, a selection process will be taking place. An early application is advantageous.

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

V Appliance and Power Tool Design
2145164, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Operation system, system of objects and system of objectives of mechatronic appliances and power tool designs.

Mode of operation as enabler of design, components of mechatronic systems, application oriented design, guidelines for appliance and power tool design.

Part of the lecture is a project work, in which theory will be reprocessed and presented in a practical way. In such exercises the students also will present their results developed in project teams.

The interaction of analysis and sysnthesis will be acquired in student teams at the example of different appliances and power tools.

Workload
regular attendance: 73,5 h

self-study: 148 h

V Appliance and Power Tool Design Project Work
2145165, SS 2019, 1 SWS, Open in study portal

Project (PRO)

Description
Media

- Beamer
- Touchscreen
- Models

Learning Content
The interaction of analysis and synthesis will be acquired in student teams at the example of different appliances and power tools.

Workload
lectures: 42 h

preparation to exam: 18 h

T 11.11 Course: Application of Advanced Programming Languages in Mechanical Engineering [T-MACH-105390]

Responsible: Dr. Daniel Weygand
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2182735	Application of advanced programming languages in mechanical engineering	2 SWS	Lecture (V)	Weygand
SS 2019	2182736	Lab - Application of advanced programming languages in mechanical engineering'	2 SWS	Practice (Ü)	Weygand
Exams					
SS 2019	76-T-MACH-105390	Application of Advanced Programming Languages in Mechanical Engineering		Prüfung (PR)	Weygand

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
It is not possible, to combine this brick with brick Scientific computing for Engineers [T-MACH-100532].

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-100532 - Scientific Computing for Engineers must not have been started.

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

V Application of advanced programming languages in mechanical engineering

Lecture (V)

2182735, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
This lecture gives an introduction to advances programming and scripting languages and numerical methods under UNIX/ Linux:

* Fortran 95/2003
- structure of source code
- progamming
- compiling
- debugging
- parallelization with OpenMP
* numerical methods
* script languages: Python, awk
* visualisation

The student can

- utilise the programming language Fortran 95 and Fortran 2003 to implement simple numerical simulations
- apply a script languages awp resp. python for data treatment

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

oral exam ca. 30 minutes

Learning Content
This lecture gives an introduction to advances programming and scripting languages and numerical methods under UNIX/ Linux:

* Fortran 95/2003
- structure of source code
- progamming
- compiling
- debugging
- parallelization with OpenMP
* numerical methods
* script languages: Python, awk
* visualisation

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

Literature

1. fortran 95/2003 explained, M. Metcalf, J. Reid, M. Cohen, Oxford University Press 2004.
2. Intel Fortran compiler handbook.

V **Lab - Application of advanced programming languages in mechanical engineering'** **Practice (Ü)**
2182736, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
* Working under Unix/Linux:
- login
- organization of files
- file system
- shell commands
- administration of jobs
- editor

* visualisation of data unter Linux

programming exercises

Application of the lecture content.

Learning Content
* Working under Unix/Linux:
- login
- organization of files
- file system
- shell commands
- administration of jobs
- editor

* visualisation of data unter Linux

programming exercises

Workload
see lecture

Literature
siehe Vorlesung

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

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

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

Competence Certificate
oral exam ca. 30 minutes

no tools or reference materials

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

Modeled Conditions
The following conditions have to be fulfilled:

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

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

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

Lecture / Practice (VÜ)

Description
Media:

black board, beamer, script, computer exercise

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

The student can

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

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

oral exam ca. 35 minutes

no tools or reference materials

admission to the exam only with successful completion of the exercises

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

Workload
regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

Literature

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

T 11.13 Course: Applied Mathematics in Natural Science: Flows with chemical reactions [T-MACH-108847]

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

Part of: M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

Type	Credits	Recurrence	Version
Completed coursework (oral)	6	Each winter term	1

Events					
WS 19/20	2153406	Flows with chemical reactions	2 SWS	Lecture (V)	Class

Competence Certificate
The study performance is considered to have been passed if all exercise assignments have been successfull processed and the final colloquium (30 minutes) has been successfully passed.

no auxiliary mean

Prerequisites
none

Recommendation
Fluid Mechanics (T-MACH-105207)

Mathematical Methods in Fluid Mechanics (T-MACH-105295)

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

V Flows with chemical reactions
2153406, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Black board

Notes
The students can describe flow scenarios, where a chemical reaktion is confined to a thin layer. They can choose simplifying approaches for the underlying chemistry and discuss the problems with focus on the fluid mechanic aspects. The students are able to solve simple problems analytically. Furthermore, they are qualified to discuss simplifications as relevant for an efficent numerical solution of complex problems.

In the lecture we mainly consider problems, where chemical reaktion is confined to a thin layer.
The problems are solved analytically or they are at least simplified allowing for efficent numerical
sollution procedures. We apply simplified chemistry and focus on the fluid mechanic aspects of the problems.

Learning Content
In the lecture we mainly consider problems, where chemical reaktion is confined to a thin layer.
The problems are solved analytically or they are at least simplified allowing for efficent numerical
sollution procedures. We apply simplified chemistry and focus on the fluid mechanic aspects of the problems.

Workload
regulare attendance: 22.5h

self-study: 99h

Literature
Lecture

Buckmaster, J.D.; Ludford, G.S.S.: Lectures on Mathematical Combustion, SIAM 1983

T 11.14 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102637 - Major Field: Tribology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

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

Competence Certificate
oral exam (20 min)

Prerequisites
None

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

V Applied Tribology in Industrial Product Development — Lecture (V)

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

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

The students are able to

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

Further content:

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

Learning Content

Friction, Wear, Wear Measurement

Lubricant (Oil, Grease, etc.)

Hydrodynamic and elastohydrodynamic Lubrication

Design of Tribologic Working Surface Pairs

Technique of Measurement in Lubricated Contacts

Prevention of Maschine Failure

Protective Surface Layers

Journal Bearings, Roller Bearings

Gear Wheels and Transmissions

Workload

regular attendance: 21 h

self-study: 99 h

Literature

The lecture script will be allocated at Ilias.

T 11.15 Course: Atomistic Simulations and Molecular Dynamics [T-MACH-105308]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102637 - Major Field: Tribology
M-MACH-102649 - Major Field: Advanced Materials Modelling
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

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

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

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

V Atomistic simulations and molecular dynamics
Lecture (V)

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

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

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

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

The student can

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

preliminary knowlegde in mathematics, physics and materials science recommended

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

oral exam ca. 30 minutes

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

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

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

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

Literature

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

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

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

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

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

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

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

Workload
see lecture

Literature
see lecture

T 11.16 Course: Automated Manufacturing Systems [T-MACH-108844]

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

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102618 - Major Field: Production Technology
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102633 - Major Field: Robotics
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Oral examination	8	Each summer term	1

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

Competence Certificate
oral exam (40 minutes)

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

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102162 - Automated Manufacturing Systems must not have been started.

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

V Automated Manufacturing Systems
Lecture / Practice (VÜ)
2150904, SS 2019, 6 SWS, Language: German, Open in study portal

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

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

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

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

Learning Outcomes:

The students ...

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

Workload:

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

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

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

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

Annotation
None

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

Literature
Lecture Notes

T 11.17 Course: Automated Manufacturing Systems [T-MACH-102162]

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

Part of: M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Written examination	9	Each summer term	2

Events					
SS 2019	2150904	Automated Manufacturing Systems	6 SWS	Lecture / Practice (VÜ)	Fleischer
Exams					
SS 2019	76-T-MACH-102162	Automated Manufacturing Systems		Prüfung (PR)	Fleischer
SS 2019	76-T-MACH-102162-MIT	Automated Manufacturing Systems		Prüfung (PR)	Fleischer

Competence Certificate
written exam (120 minutes)

Prerequisites
"T-MACH-108844 - Automatisierte Produktionsanlagen" must not be commenced.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108844 - Automated Manufacturing Systems must not have been started.

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

V Automated Manufacturing Systems

Lecture / Practice (VÜ)

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

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

Notes

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

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

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

Learning Outcomes:

The students ...

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

Workload:

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

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

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

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

Annotation
None

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

Literature
Lecture Notes

T 11.18 Course: Automation Systems [T-MACH-105217]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102614 - Major Field: Mechatronics

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

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

Competence Certificate
Written exam (Duration: 1 h)

Prerequisites
none

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

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

Lecture (V)

Learning Content

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

Workload
general attendance: 21 h

self-study: 99 h

Literature

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

T 11.19 Course: Automotive Engineering I [T-MACH-100092]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

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

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

Competence Certificate
Written examination

Duration: 120 minutes

Auxiliary means: none

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

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

V Automotive Engineering I
2113805, WS 19/20, 4 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. History and future of the automobile

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

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

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

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

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

Literature

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

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

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

V **Automotive Engineering I** **Lecture (V)**

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

Notes

In English language.

Learning Content

1. History and future of the automobile

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

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

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

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

Workload

regular attendance: 45 hours
self-study: 195 hours

Literature

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

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

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

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

T 11.20 Course: Automotive Engineering II [T-MACH-102117]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

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

Competence Certificate
Written Examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

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

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

Lecture (V)

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

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

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

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

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

V

Automotive Engineering II

2114855, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes

In English language.

Learning Content

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

Literature

Elective literature:

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

T 11.21 Course: Automotive Logistics [T-MACH-105165]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2118085	Automotive Logistics	2 SWS	Lecture (V)	Furmans
Exams					
SS 2019	76-T-MACH-105165	Automotive Logistics		Prüfung (PR)	Furmans, Mittwollen

Competence Certificate
The assessment consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

Prerequisites
none

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

V Automotive Logistics
2118085, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

presentations, black board

Notes
The event will be offered for the last time in the summer semester 2019.

Learning Content

- Logistic questions within the automobile industry
- basic model of automobile production and distribution
- relation with the suppliers
- Disposition and physical execution
- Vehicle production in the interaction of shell, paint shop and assembly
- Sequence planning
- Assembly supply
- vehicle distribution and linkage with selling processes
- Physical execution, planning and control

Annotation
none

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

Literature
None.

T 11.22 Course: Automotive Vision [T-MACH-105218]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102624 - Major Field: Information Technology
M-MACH-102625 - Major Field: Information Technology of Logistic Systems
M-MACH-102630 - Major Field: Mobile Machines
M-MACH-102633 - Major Field: Robotics
M-MACH-102641 - Major Field: Rail System Technology

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

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

Competence Certificate
Type of Examination: written exam

Duration of Examination: 60 minutes

Prerequisites
none

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

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

Notes

Lernziele (EN):

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

Lehrinhalt (EN):

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

Arbeitsaufwand (EN): 120 hours

Learning Content

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

Workload

120 hours

T 11.23 Course: Basics of Technical Logistics [T-MACH-102163]

Responsible: Dr.-Ing. Martin Mittwollen
Jan Oellerich

Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102618 - Major Field: Production Technology
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	4

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

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

Prerequisites
none

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

V Basics of Technical Logistics
2117095, WS 19/20, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

supplementary sheets,presentations, blackboard

Notes
lectures and practice; practice dates: look up ILIAS

Learning Content

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

Annotation
Basics knowledge of technical mechanics is preconditioned

Workload
presence: 48h

rework: 132h

Literature
Recommendations during lessons

T 11.24 Course: Basics of Technical Logistics I [T-MACH-109919]

Responsible: Dr.-Ing. Martin Mittwollen
Jan Oellerich

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Competence Certificate
The assessment consists of a written exam (60 min.) according to § 4 paragraph 2 Nr. 1 of the examination regulation.

Prerequisites
none

T 11.25 Course: Basics of Technical Logistics II [T-MACH-109920]

Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Written examination	5	Each winter term	1

Competence Certificate
The assessment consists of a written exam (60 min.) according to § 4 paragraph 2 Nr. 1 of the examination regulation.

Prerequisites
none

T 11.26 Course: Behaviour Generation for Vehicles [T-MACH-105367]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102624 - Major Field: Information Technology
M-MACH-102630 - Major Field: Mobile Machines
M-MACH-102633 - Major Field: Robotics
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

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

Competence Certificate
written examination

60 min.

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

Prerequisites
none

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

V Behaviour Generation for Vehicles

2138336, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Lernziele (EN):

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

Workload
120 hours

T 11.27 Course: Bioelectric Signals [T-ETIT-101956]

Responsible: Dr.-Ing. Axel Loewe
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	2

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

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

T 11.28 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-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

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

Competence Certificate
Colloquium, ungraded.

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

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

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

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

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

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

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

Responsible: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Written examination	3	Each winter term	1

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

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

T 11.30 Course: Biomedical Measurement Techniques II [T-ETIT-106973]

Responsible: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	1

Events					
SS 2019	2305270	Biomedical Measurement Techniques II	2 SWS	Lecture (V)	Nahm
Exams					
SS 2019	7305270	Biomedical Measurement Techniques II		Prüfung (PR)	Nahm

T 11.31 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

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

Competence Certificate
written exam (75 Min.)

Prerequisites
none

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

V BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I — Lecture (V)
2141864, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Lecture script

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

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

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature

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

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

T 11.32 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

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

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

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

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

2142883, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Lecture script

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

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature

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

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

M. Madou
Fundamentals of Microfabrication

T 11.33 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

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

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

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

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

Lecture (V)

Description
Media:

Lecture script

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

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature

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

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

M. Madou
Fundamentals of Microfabrication

T 11.34 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine IV [T-MACH-106877]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2141102	BioMEMS IV - Microsystems technology for Life Sciences and Medicine	2 SWS	Lecture (V)	Guber, Ahrens, Doll, Länge, Rajabi, Finkbeiner
Exams					
SS 2019	76-T-MACH-106877	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine IV		Prüfung (PR)	Guber

Competence Certificate
Oral examination (45 Min.)

Prerequisites
none

T 11.35 Course: Bionic Inspired Reinforced Composites [T-MACH-106723]

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

Part of: M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2126811	Bionic Inspired Reinforced Composites	2 SWS	Lecture (V)	Koch
Exams					
SS 2019	76T-MACH-106723	Bionic Inspired Reinforced Composites		Prüfung (PR)	Koch

Competence Certificate
oral exam

T 11.36 Course: Bionics for Engineers and Natural Scientists [T-MACH-102172]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

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

Competence Certificate
written or oral exam

Prerequisites
none

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

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

Lecture (V)

Description
Media:

Slides of the lectures

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

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

Basic knowledge in physics and chemistry

lectures 30 h

self study 30 h

preparation for examination 30 h

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

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

Workload
lectures 30 h

self study 30 h

preparation for examination 30 h

Literature

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

T 11.37 Course: Boosting of Combustion Engines [T-MACH-105649]

Responsible: Dr.-Ing. Johannes Kech
Dr.-Ing. Heiko Kubach

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2134153	Boosting of Combustion Engines	2 SWS		Kech

Competence Certificate
oral exam, 20 min

Prerequisites
none

T 11.38 Course: BUS-Controls [T-MACH-102150]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102624 - Major Field: Information Technology
M-MACH-102630 - Major Field: Mobile Machines

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

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

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

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

Modeled Conditions
The following conditions have to be fulfilled:

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

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

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

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

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

Content:

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

Literature:

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

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

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

Learning Content

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

Annotation

The course will be replenished by interesting lectures of professionals.

Workload

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

Literature

Elective literature:

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

T 11.39 Course: BUS-Controls - Advance [T-MACH-108889]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102624 - Major Field: Information Technology
M-MACH-102630 - Major Field: Mobile Machines

Type	Credits	Recurrence	Version
Completed coursework	0	Each summer term	1

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

Competence Certificate
Creation of control program

Prerequisites
none

T 11.40 Course: Business Administration for Engineers and IT professionals [T-MACH-109933]

Responsible: Peter Sebregondi
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102613 - Major Field: Lifecycle Engineering

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

Events					
SS 2019	2122303	Business Administration for Engineers and IT professionals	2 SWS	Seminar (S)	Sebregondi
WS 19/20	2122303	Business Administration for Engineers and IT professionals	2 SWS	Seminar (S)	Sebregondi
Exams					
SS 2019	76-T-MACH-109933	Business Administration for Engineers and IT professionals		Prüfung (PR)	Sebregondi

Competence Certificate
Assessment of another type. Two presentations and six written compositions in team work. Grading: each composition 1/8 and each presentation 1/8.

Prerequisites
None

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

V Business Administration for Engineers and IT professionals

2122303, SS 2019, 2 SWS, Open in study portal

Seminar (S)

Notes
Number of participants limited to 30 people.

V Business Administration for Engineers and IT professionals

2122303, WS 19/20, 2 SWS, Language: German, Open in study portal

Seminar (S)

Notes
Number of participants limited to 30 people.

T 11.41 Course: Business Planning [T-WIWI-102865]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104323 - Major Field: Innovation and Entrepreneurship

Type	Credits	Recurrence	Version
Examination of another type	3	Each term	1

Events					
SS 2019	2545005	Geschäftsplanung für Gründer (Track 1)	2 SWS	Seminar (S)	Terzidis, Tittel, Ntagiakou
WS 19/20	2545007	Business Planning for Founders (ENTECH)	2 SWS	Seminar (S)	Wohlfeil, Bauman
WS 19/20	2545020	Business Planning for Founders (EUCOR Edition)	2 SWS	Seminar (S)	Terzidis
Exams					
SS 2019	7900054	Business Planning		Prüfung (PR)	Terzidis

Competence Certificate
Non exam assessment (§4 (2), 3 SPO 2007) respectively alternative exam assessments (§4(2), 3 SPO 2015).

Prerequisites
None

Recommendation
None

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

V Geschäftsplanung für Gründer (Track 1)

2545005, SS 2019, 2 SWS, Language: German, Open in study portal

Seminar (S)

Description
This seminar introduces basic concepts of business planning for entrepreneurs to the participants. It focusses on practical concepts andhands-on-methods on how to turn business ideas into solid businesses (e.g. Business Modelling, Market Potential, Planning of Ressorces, and further more) and on the creation of a realistic and viable Business Plan (with or without Venture Capital)

V Business Planning for Founders (EUCOR Edition)

2545020, WS 19/20, 2 SWS, Language: English, Open in study portal

Seminar (S)

Description
This seminar introduces basic concepts of business planning for entrepreneurs to the participants. It focusses on practical concepts andhands-on-methods on how to turn business ideas into solid businesses (e.g. Business Modelling, Market Potential, Planning of Ressorces, and further more) and on the creation of a realistic and viable Business Plan (with or without Venture Capital)

Annotation
Please register on the seminar website.

WARNING: creditability in Seminar Module

The EnTechnon seminars are NOT accepted in the seminar module! The credit is only possible in MODULE ENTREPRENEURSHIP. OneException is the seminar "Entrepreneurship Research".

T 11.42 Course: CAD-NX Training Course [T-MACH-102187]

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

Part of: M-MACH-102613 - Major Field: Lifecycle Engineering

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

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

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

Prerequisites
None

Recommendation
Dealing with technical drawings is required.

Annotation
For the practical course compulsory attendance exists.

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

V CAD-NX training course

2123357, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
The participant will learn the following knowledge:

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

Annotation
For the practical course compulsory attendance exists.

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

Literature
Practical course skript

V **CAD-NX training course** **Practical course (P)**

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

Learning Content
The participant will learn the following knowledge:

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

Annotation
For the practical course compulsory attendance exists.

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

Literature
Practical course skript

T 11.43 Course: CAE-Workshop [T-MACH-105212]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

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

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

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

Prerequisites
None

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

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

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

Block (B)

Notes

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

Workload
regular attendance: 31.5 h

self-study: 58 h

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

discussing and presenting results in small groups

V **CAE-Workshop** **Block (B)**
2147175, WS 19/20, 3 SWS, Language: German, Open in study portal

Notes

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

Workload
regular attendance: 31.5 h

self-study: 58 h

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

discussing and presenting results in small groups

T 11.44 Course: CATIA Advanced [T-MACH-105312]

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

Part of: M-MACH-102613 - Major Field: Lifecycle Engineering

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

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

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

Prerequisites
none

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

V CATIA advanced

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

Project (PRO)

Learning Content

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

Annotation
For the workshop compulsory attendance exists.

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

T 11.45 Course: Ceramic Matrix Composites [T-MACH-106722]

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

Part of: M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

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

Competence Certificate
oral exam

T 11.46 Course: Ceramic Processing Technology [T-MACH-102182]

Responsible: Dr. Joachim Binder
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2126730	Ceramics Processing	2 SWS	Lecture (V)	Binder
Exams					
SS 2019	76-T-MACH-102182	Ceramic Processing Technology		Prüfung (PR)	Binder
WS 19/20	76-T-MACH-102182	Ceramic Processing Technology		Prüfung (PR)	Binder

Competence Certificate
The assessment consists of an oral exam (approx. 20 min) taking place at the agreed date.

Auxiliary means: none

The re-examination is offered upon agreement.

Prerequisites
none

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

V Ceramics Processing
Lecture (V)

2126730, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
The course imparts technological basics for processing of engineering ceramics. The course is arranged in the following units:

- Synthesis methods
- Powder conditioning and mixing methods
- Forming of ceramics
- Sintering
- Finishing processes
- Ceramic films and multi-layer systems
- Effects of processing on properties

Workload
regular attendance: 21 hours

self-study: 99 hours

Literature
W. Kollenberg: Technische Keramik, Vulkan Verlag 2010.

M. N. Rahaman: Ceramic Processing, CRC Taylor & Francis, 2007.

D.W. Richerson: Modern ceramic engineering, CRC Taylor & Francis, 2006.

A. G. King: Ceramic Technology and Processing, William Andrew, 2002.

T 11.47 Course: CFD in Power Engineering [T-MACH-105407]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

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

Competence Certificate
Oral exam, 30 min

Prerequisites
none

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

V CFD for Power Engineering

2130910, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

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

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

Learning Content

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

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

Annotation

CFD Project:

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

Workload

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

Literature

Course note packet

Project package

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

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

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

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

Part of: M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

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

Competence Certificate
Successful solution of problems

Prerequisites
none

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

CFD-Lab using OpenFOAM

2169459, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Description
Media:

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

Learning Content

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

Annotation

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

Workload

- 5 days of 8 h = 40 h

Literature

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

T 11.49 Course: Coal Fired Power Plants [T-MACH-105410]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

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

Competence Certificate
Oral examination, Duration approximately 30 Minutes

no tools or reference materials may be used during the exam

Prerequisites
none

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

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

Lecture (V)

Notes
This lecture will be omitted until further

T 11.50 Course: Cognitive Automobiles - Laboratory [T-MACH-105378]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102633 - Major Field: Robotics
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

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

Competence Certificate
oral exam

30 minutes

Prerequisites
none

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

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

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

Notes
Lehrinhalt (EN):

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

Lernziele (EN):

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

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

Workload
120 hours

T 11.51 Course: Cognitive Systems [T-INFO-101356]

Responsible: Prof. Dr.-Ing. Rüdiger Dillmann
Prof. Dr. Alexander Waibel

Organisation: KIT Department of Informatics

Part of: M-MACH-102609 - Major Field: Cognitive Technical Systems

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

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

T 11.52 Course: Combined Cycle Power Plants [T-MACH-105444]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

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

Competence Certificate
oral exam ca. 30 min

Prerequisites
none

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

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

V Combined Cycle Power Plants

2170490, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Description
Media:

Lecture with English Power Point Presentation

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

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

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

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

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

Workload
Regular attendance: 32 hours

Self study: 88 hours

Literature
Power point slides and other lecture material will be provided.

Recommended additional literature:

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

T 11.53 Course: Combustion Diagnositics [T-MACH-105429]

Responsible: Prof. Dr. Ulrich Maas
Dr.-Ing. Robert Schießl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102635 - Major Field: Engineering Thermodynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2167048	Combustion diagnositics	2 SWS	Lecture (V)	Schießl
WS 19/20	2167048	Combustion diagnositics	2 SWS	Lecture (V)	Schießl

Competence Certificate
Oral exam (20 min)

Prerequisites
none

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

V Combustion diagnositics

Lecture (V)

2167048, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Diagnostical methods: Laser induced fluorescence, Rayleigh-scattering, Raman-scattering
Chemoluminescence.
Reduced description of combustion processes and measurements.
Discussion of the potential and limits of specific strategies in different combustion systems.

Workload
Regular attendance: 22 hours

Self-study, exam preparation: 100,0 hours

Literature
Lecture notes

A.C. Eckbreth, Laser Diagnostics for Combustion Temperature and Species, Abacus Press, 2nd ed. (1996)

W. Demtröder, Laser Spectroscopy: Basic Concepts and Instrumentation, Springer, 3rd ed., 2003

Hollas J.M. Modern Spectroscopy, Wiley, 3rd ed., 1996
K. Kohse-Höinghaus, J. B. Jeffries (ed.), Applied Combustion Diagnostics, Taylor and Francis

Atkins P., Paula, J., Physical Chemistry, 8th ed., Oxford University Press, 2006

V Combustion diagnositics

Lecture (V)

2167048, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
Diagnostical methods: Laser induced fluorescence, Rayleigh-scattering, Raman-scattering
Chemoluminescence.
Reduced description of combustion processes and measurements.
Discussion of the potential and limits of specific strategies in different combustion systems.

Workload
Regular attendance: 22.5 h

Self-study, exam preparation: 97.5 h

Literature
Lecture notes

A.C. Eckbreth, Laser Diagnostics for Combustion Temperature and Species,
Abacus Press, 2nd ed. (1996)

W. Demtröder, Laser Spectroscopy: Basic Concepts and Instrumentation,
Springer, 3rd ed., 2003

Hollas J.M. Modern Spectroscopy, Wiley, 3rd ed., 1996
K. Kohse-Höinghaus, J. B. Jeffries (ed.), Applied Combustion Diagnostics,
Taylor and Francis

Atkins P., Paula, J., Physical Chemistry, 8th ed., Oxford University Press,
2006

T 11.54 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-102599 - Major Field: Powertrain Systems
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102630 - Major Field: Mobile Machines
M-MACH-102635 - Major Field: Engineering Thermodynamics
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

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

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

Prerequisites
none

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

V Combustion Engines I
Lecture / Practice (VÜ)

2133113, WS 19/20, 4 SWS, Language: German, Open in study portal

Notes
Introduction, History, Concepts

Working Principle and Applications

Characteristic Parameters

Engine Parts

Drive Train

Fuels

Gasoline Engines

Diesel Engines

Exhaust Gas Aftertreatment

Learning Content

Introduction, History, Concepts

Working Principle and Applications

Characteristic Parameters

Engine Parts

Drive Train

Fuels

Gasoline Engines

Diesel Engines

Exhaust Gas Aftertreatment

Workload

regular attendance: 32 hours
self-study: 88 hours

T 11.55 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-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	5	Each summer term	1

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

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

Prerequisites
none

Recommendation
Fundamentals of Combustion Engines I helpful

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

V Combustion Engines II

2134151, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Learning Content
Emissions

Fuels

Drive Train Dynamics

Engine Parts

Boosting

Alternative Powertrain Concepts

Special Engine Concepts

Power Transmission

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

T 11.56 Course: Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies [T-MACH-105535]

Responsible: Prof. Dr.-Ing. Frank Henning

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102632 - Major Field: Polymer Engineering
M-MACH-102641 - Major Field: Rail System Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

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

Competence Certificate
written exam 90 minutes

Prerequisites
none

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

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

Lecture (V)

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

Learning Content
Physical connections of fiber reinforcement

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

resins
thermoplastics
duromeres

mechanisms of reinforcements
glas fibers
carbon fibers
aramid fibers
natural fibers

semi-finished products - textiles

process technologies - prepregs

recycling of composites

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

T 11.57 Course: Computational Dynamics [T-MACH-105349]

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

Part of: M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2162246	Computational Dynamics	2 SWS		Proppe

Competence Certificate
oral exam, 30 min.

Prerequisites
none

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

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

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

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

Workload
Lectures: 20 h

Self-studies: 100 h

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

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

T 11.58 Course: Computational Homogenization on Digital Image Data [T-MACH-109302]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

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

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

Competence Certificate
oral exam, 30 min

Prerequisites
nein

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

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

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

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

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

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

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

V **Computational homogenization on digital image data (Tutorial)** **Practice (Ü)**

2161124, WS 19/20, 2 SWS, Language: English, **Open in study portal**

Notes

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

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

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102624 - Major Field: Information Technology
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

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

Competence Certificate
Written exam (Duration: 1h)

Prerequisites
none

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

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

Lecture (V)

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

Content:

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

Learning objectives:

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

Learning Content

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

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

Literature
Lecture notes (ILIAS)

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

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

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

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

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

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

T 11.60 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102646 - Major Field: Applied Mechanics

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	2

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

Competence Certificate
oral examination, 30 min.

Prerequisites
none

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

This course is geared to MSc students.

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

V Computational Mechanics I (Tutorial) — Practice (Ü)
2161147, WS 19/20, 2 SWS, Language: German, Open in study portal

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

V Computational Mechanics I — Lecture (V)
2161250, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content

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

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

Literature

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

T 11.61 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102646 - Major Field: Applied Mechanics

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	2

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

Competence Certificate
oral examination, 30 min.

Prerequisites
none

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

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

Lecture (V)

Learning Content

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

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

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

T 11.62 Course: Computational Vehicle Dynamics [T-MACH-105350]

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

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102641 - Major Field: Rail System Technology
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2162256	Computational Vehicle Dynamics	2 SWS	Lecture (V)	Proppe

Competence Certificate
oral exam, 30 min.

Prerequisites
none

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

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

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

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

Workload
Lectures: 20 h

Self-studies: 100 h

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

T 11.63 Course: Computer Engineering [T-MACH-105360]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102624 - Major Field: Information Technology
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

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

Competence Certificate
written exam (Duration: 2 hours)

Prerequisites
none

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

V Computer Engineering

2106002, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content:

Introduction: definitions, basic concepts, introductory examples

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

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

Sorting algorithms: relevance, algorithms, simplifications, examples

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

Lectures are complemented by an exercice course.

Learning objectives:

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

Learning Content
Introduction: definitions, basic concepts, introductory examples

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

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

Sorting algorithms: relevance, algorithms, simplifications, examples

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

Lectures are complemented by an exercice course.

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

Literature
Lecture Notes (Ilias)

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

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

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

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

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

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

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

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

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

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

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

T 11.64 Course: Computerized Multibody Dynamics [T-MACH-105384]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102633 - Major Field: Robotics
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Competence Certificate
Oral exam, 30 min.

Prerequisites
none

Recommendation
Knowledge of EM III/IV

T 11.65 Course: Constitution and Properties of Protective Coatings [T-MACH-105150]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

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

Competence Certificate
oral examination (about 30 min)

no tools or reference materials

Prerequisites
none

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

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

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

Teaching Content:

introduction and overview

concepts of surface modification

coating concepts

coating materials

methods of surface modification

coating methods

characterization methods

state of the art of industrial coating of tools and components

new developments of coating technology

regular attendance: 22 hours
self-study: 98 hours

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

Learning Content
introduction and overview

concepts of surface modification

coating concepts

coating materials

methods of surface modification

coating methods

characterization methods

state of the art of industrial coating of tools and components

new developments of coating technology

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

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

Copies with figures and tables will be distributed

T 11.66 Course: Constitution and Properties of Wearresistant Materials [T-MACH-102141]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102637 - Major Field: Tribology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

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

Competence Certificate
oral examination (about 30 min)

no tools or reference materials

Prerequisites
none

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

V Constitution and Properties of Wear resistant materials
2194643, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

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

Teaching Content:

introduction

materials and wear

unalloyed and alloyed tool steels

high speed steels

stellites and hard alloys

hard materials

hard metals

ceramic tool materials

superhard materials

new developments

regular attendance: 22 hours
self-study: 98 hours

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

Learning Content
introduction

materials and wear

unalloyed and alloyed tool steels

high speed steels

stellites and hard alloys

hard materials

hard metals

ceramic tool materials

superhard materials

new developments

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

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

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

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

Copies with figures and tables will be distributed

T 11.67 Course: Contact Mechanics [T-MACH-105786]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102637 - Major Field: Tribology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

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

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowledge in mathematics, physics and materials science

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

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

Lecture (V)

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

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

The student

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

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam ca. 30 minutes

Learning Content

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

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

Workload

regular attendance: 22,5 hours

self-study: 97,5 hours

Literature

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

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

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

T 11.68 Course: Control Technology [T-MACH-105185]

Responsible: Christoph Gönnheimer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102618 - Major Field: Production Technology
M-MACH-102624 - Major Field: Information Technology
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

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

Competence Certificate
Written Exam (60 min)

Prerequisites
none

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

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

Lecture (V)

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

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

The following topics will be covered:

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

Learning Outcomes:

The students ...

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

Workload:

regular attendance: 21 hours
self-study: 99 hours

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

The following topics will be covered:

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

Annotation
None

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

T 11.69 Course: Cooling of Thermally High Loaded Gas Turbine Components [T-MACH-105414]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

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

Competence Certificate
oral exam, 30 min.

Prerequisites
none

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

V Cooling of thermally high loaded gas turbine components
Lecture (V)

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

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

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

11.70 Course: Current Topics on BioMEMS [T-MACH-102176]

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

Part of: M-MACH-102616 - Major Field: Microsystem Technology

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

Events					
SS 2019	2143873	Actual topics of BioMEMS	2 SWS	Seminar (S)	Guber
WS 19/20	2143873	Actual topics of BioMEMS	2 SWS	Seminar (S)	Guber
Exams					
SS 2019	76-T-MACH-102176	Current Topics on BioMEMS		Prüfung (PR)	Guber

Competence Certificate
active participation and own presentation (30 Min.)

Prerequisites
none

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

Actual topics of BioMEMS
2143873, SS 2019, 2 SWS, Language: German, Open in study portal — **Seminar (S)**

Description
Media:
Written preparations from the participants.

Workload
Active participation on the seminary and preparation of an own presentation of a topic in BioMEMS.

Lecture time: 21 h

Preparation: 40 h

Preparation of own preparation: 60 h

Actual topics of BioMEMS
2143873, WS 19/20, 2 SWS, Language: German, Open in study portal — **Seminar (S)**

Description
Media:

Written preparations from the participants.

Workload
Active participation on the seminary and preparation of an own presentation of a topic in BioMEMS.

Lecture time: 21 h

Preparation: 40 h

Preparation of own preparation: 60 h

T 11.71 Course: Data Analytics for Engineers [T-MACH-105694]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102624 - Major Field: Information Technology
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	2

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

Competence Certificate
Written exam (Duration: 1h)

Prerequisites
none

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

V Data Analytics for Engineers
2106014, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes
Content:

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

Learning objectives:

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

Learning Content

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

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

Literature
Lecture notes (ILIAS)

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

2008 (free PDF in the Internet)

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

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

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

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

T 11.72 Course: Decentrally Controlled Intralogistic Systems [T-MACH-105230]

Responsible: Prof. Dr.-Ing. Kai Furmans
Maximilian Hochstein

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	3

Events					
SS 2019	2117084	Decentrally controlled intralogistic systems	2 SWS	Practical course (P)	Furmans, Hochstein, Markert
WS 19/20	2117084	Decentrally controlled intralogistic systems	2 SWS	Practical course (P)	Furmans, Hochstein
Exams					
SS 2019	76-T-MACH-105230	Decentrally Controlled Intralogistic Systems		Prüfung (PR)	Furmans

Competence Certificate
Certificate by colloquium with presentation

Prerequisites
None

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

V Decentrally controlled intralogistic systems
2117084, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Description
Media:

Lego Mindstorms, PC

Learning Content

- Introduction to material handling systems
- Construction of a model for decentralized logistic systems
- object-oriented programming with LabView
- Implementation of the model with Mindstorms

Presentation of the results

Annotation
number of participants limited

participants will be selected

One course during summer semester in english

Workload
regular attendance: 10 hours
self-study: 80 hours (workplace is provided)

Literature
none

V **Decentrally controlled intralogistic systems** **Practical course (P)**

2117084, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Lego Mindstorms, PC

Learning Content

- Introduction to material handling systems
- Construction of a model for decentralized logistic systems
- object-oriented programming with LabView
- Implementation of the model with Mindstorms

Presentation of the results

Annotation
number of participants limited

participants will be selected

One course during summer semester in english

Workload
regular attendance: 10 hours
self-study: 80 hours (workplace is provided)

Literature
none

T 11.73 Course: Design and Development of Mobile Machines [T-MACH-105311]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102630 - Major Field: Mobile Machines

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

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

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

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

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

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

Modeled Conditions
The following conditions have to be fulfilled:

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

Recommendation
Knowledge in Fluid Power Systems (LV 2114093)

Annotation
After completion of the lecture, studens can:

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

The number of participants is limited.

Conent:

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

Literature:

See german recommendations

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

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

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

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

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

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

Workload

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

Literature
None.

T 11.74 Course: Design and Development of Mobile Machines - Advance [T-MACH-108887]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102630 - Major Field: Mobile Machines

Type	Credits	Recurrence	Version
Completed coursework	0	Each term	1

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

Competence Certificate
Preparation of semester report

Prerequisites
none

T 11.75 Course: Design of a jet engine combustion chamber [T-CIWVT-105780]

Responsible: Prof. Dr.-Ing. Nikolaos Zarzalis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-102627 - Major Field: Energy Converting Engines

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	2

Events					
WS 19/20	22527	Design of a Jet Engine Combustion Chamber	SWS		Zarzalis

Competence Certificate
The examination is an oral examination on lecture 22527 with a duration of 20 minutes.

Prerequisites
None

T 11.76 Course: Design of Highly Stresses Components [T-MACH-105310]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102636 - Major Field: Thermal Turbomachines
M-MACH-102643 - Major Field: Fusion Technology
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

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

Competence Certificate
oral exam

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

V Design of highly stresses components

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

Lecture (V)

Learning Content
Contents of the lecture:

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

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

Literature

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

T 11.77 Course: Design Thinking [T-WIWI-102866]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104323 - Major Field: Innovation and Entrepreneurship

Type	Credits	Recurrence	Version
Examination of another type	3	Each term	1

Events					
SS 2019	2545008	Design Thinking (Track 1)	2 SWS	Seminar (S)	Terzidis, Jochem, Lau
WS 19/20	2545008	Design Thinking (Track 1)	2 SWS	Seminar (S)	Jochem, Terzidis, Lau
Exams					
SS 2019	7900053	Design Thinking (Track 1)		Prüfung (PR)	Terzidis

Competence Certificate
Alternative exam assessments (§4(2), 3 SPO).

Prerequisites
None

Recommendation
None

Annotation
The seminar content will be published on the website of the institute.

T 11.78 Course: Design with Plastics [T-MACH-105330]

Responsible: Markus Liedel
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102632 - Major Field: Polymer Engineering
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

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

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Poly I

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

V Design with Plastics

2174571, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

Structure and properties of plastics materials,

Processing of plastics,

Behavior of plastics under environmental impacts,

Classic strength dimensioning,

Geometric dimensioning,

Plastic appropriate design,

Failure examples,

Joining of plastic parts,

Supporting simulation tools,

Structural foams,

Plastics Technology trends.

learning objectives:

Students will be able to

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

requirements:

none,

recommendation: Polymerengineering I

workload:

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

Learning Content

Structure and properties of plastics materials,

Processing of plastics,

Behavior of plastics under environmental impacts,

Classic strength dimensioning,

Geometric dimensioning,

Plastic appropriate design,

Failure examples,

Joining of plastic parts,

Supporting simulation tools,

Structural foams,

Plastics Technology trends.

Workload

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

Literature

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

T 11.79 Course: Designing with Composites [T-MACH-108721]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102628 - Major Field: Lightweight Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

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

Competence Certificate
Oral exam, 20 minutes

Prerequisites
None

Annotation
The lecture notes are made available via ILIAS.

T 11.80 Course: Designing with numerical methods in product development [T-MACH-108719]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102605 - Major Field: Engineering Design

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2161229	Designing with numerical methods in product development	2 SWS	Lecture (V)	Schnack
Exams					
SS 2019	76-T-MACH-108719	Designing with numerical methods in product development		Prüfung (PR)	

Competence Certificate
Oral examination (duration: 20 min)

Prerequisites
None

Annotation
The lecture notes are made available via ILIAS.

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

V Designing with numerical methods in product development

Lecture (V)

2161229, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
Overview of the numeric process: finite difference methods, finite volume methods. Finite element methods. Boundary element method (BEM). Thermodynamic processes. Flow dynamic processes. Solid dynamics. Non-linear field behaviour. These methods are summarised at the end of the course, and a holistic concept for design processes is developed.

Workload
Contact time: 22.5 hrs; Self-study: 97.5 hrs

Literature
Lecture notes (available in the administration office, building 10.91, rm. 310)

T 11.81 Course: Development of Oil-Hydraulic Powertrain Systems [T-MACH-105441]

Responsible: Isabelle Ays
Dr.-Ing. Gerhard Geerling

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102618 - Major Field: Production Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102630 - Major Field: Mobile Machines
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

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

Competence Certificate
oral exam (20 min)

Prerequisites
none

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

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

Block (B)

Notes
Place and time see institute homepage

Learning Content
The bloc course offered by the Chair of Mobile Machines (Mobima) conveys the basics of planning and development of mobile and industrial hydrostatic systems. The lecturer works for a market leading company producing fluid power drives and controls and gives a deep view into the process of planning and development using real life examples. The contents of the course are:

- marketing, project planning
- hydrostatic circuits
- heat balance, hydraulic accumulators
- filtration, noise lowering
- development exercises + laboratory tutorial

Workload

- regular attendance: 19 hours
- self-study: 90 hours

T 11.82 Course: Digital Control [T-MACH-105317]

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

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102624 - Major Field: Information Technology
M-MACH-102629 - Major Field: Logistics and Material Flow Theory
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2137309	Digital Control	2 SWS	Lecture (V)	Knoop
Exams					
SS 2019	76-T-MACH-105317	Digital Control		Prüfung (PR)	Stiller
WS 19/20	76-T-MACH-105317	Digital Control		Prüfung (PR)	Stiller

Competence Certificate
written exam

60 min.

Prerequisites
none

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

V Digital Control
2137309, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Lehrinhalt (EN):

1. Introduction into digital control:
Motivation for digital implementation of controllers Structure of digital feedback control loops Sample and hold units
2. State space analysis and design:
Discretisation of continuous-time systems Discrete-time state space equations Stability - definition and criteria State feedback design by eigenvalue assignment PI state feedback controller Luenberger observer, separation theorem
Systems with dead-time Deadbeat design
3. Analysis and design based on z-transform: z-transform - definition and theorems Control loop description in the z domain Stability criteria Root locus controller design Transfer of continuous-time controllers into discrete-time controllers

Voraussetzungen (EN):

Basic studies and preliminary examination; basic lectures in automatic control

Lernziele (EN):

The lecture intoduces key methods for the analysis and design of digital feedback control systems. Starting point is the discretisation of linear, continuous-time models. State space based and z-transform based controller design techniques are presented for discrete-time, single-input single-output systems. Furthermore, plants with dead-time and deadbeat design are covered.

Learning Content
1. Introduction into digital control:
Motivation for digital implementation of controllers Structure of digital feedback control loops Sample and hold units
2. State space analysis and design:
Discretisation of continuous-time systems Discrete-time state space equations Stability - definition and criteria State feedback design by eigenvalue assignment PI state feedback controller Luenberger observer, separation theorem
Systems with dead-time Deadbeat design
3. Analysis and design based on z-transform: z-transform - definition and theorems Control loop description in the z domain Stability criteria Root locus controller design Transfer of continuous-time controllers into discrete-time controllers

Workload
120 hours

Literature

- Lunze, J.: Regelungstechnik 2, 3. Auflage, Springer Verlag, Berlin Heidelberg 2005
- Unbehauen, H.: Regelungstechnik, Band 2: Zustandsregelungen, digitale und nichtlineare Regelsysteme. 8. Auflage, Vieweg Verlag, Braunschweig 2000
- Föllinger, O.: Lineare Abtastsysteme. 4. Auflage, R. Oldenbourg Verlag, München Wien 1990
- Ogata, K.: Discrete-Time Control Systems. 2nd edition, Prentice-Hall, Englewood Cliffs 1994
- Ackermann, J.: Abtastregelung, Band I, Analyse und Synthese. 3. Auflage, Springer Verlag, Berlin Heidelberg 1988

T 11.83 Course: Digital microstructure characterization and modeling [T-MACH-110431]

Responsible: Prof. Dr. Matti Schneider
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102646 - Major Field: Applied Mechanics

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Competence Certificate
oral examination

T 11.84 Course: Digitalization from Production to the Customer in the Optical Industry [T-MACH-110176]

Responsible: Dr. Marc Wawerla
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102618 - Major Field: Production Technology

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

Events					
WS 19/20	2149701	Digitalization from Production to the Customer in the Optical Industry	2 SWS	Lecture (V)	Wawerla

Competence Certificate
Alternative test achievement (graded):
- Processing and presentation (ca. 15 min) of a case study with weighting 20%
- Oral exam (ca. 20 min) with weighting 80%

Prerequisites
none

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

V Digitalization from Production to the Customer in the Optical Industry
2149701, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Description
The lecture deals with Digitalization along the entire value chain end-to-end, with a focus on production and supply chain. Within this context, concepts, tools, methods, technologies and concrete applications in the industry are presented. Furthermore, the students get the opportunity to get first-hand insights into the digitalization journey of a German technology company.

Main topics of the lecture:

- Concepts and methods such as disruptive innovation and agile project management
- Overview on technologies at disposal
- Practical approaches in innovation
- Applications in industry
- Field trip to ZEISS

Notes

The lecture deals with Digitalization along the entire value chain end-to-end, with a focus on production and supply chain. Within this context, concepts, tools, methods, technologies and concrete applications in the industry are presented. Furthermore, the students get the opportunity to get first-hand insights into the digitalization journey of a German technology company.

Main topics of the lecture:

- Concepts and methods such as disruptive innovation and agile project management
- Overview on technologies at disposal
- Practical approaches in innovation
- Applications in industry
- Field trip to ZEISS

Learning Outcomes:

The students ...

- are capable to comment on the content covered by the lecture.
- are able to analyze and evaluate the suitability of digitalization technologies in the optical industry.
- are able to assess the applicability of methods such as disruptive innovation and agile project management.
- are able to appreciate the practical challenges to digitalization in industry.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Workload

regular attendance: 21 hours
self-study: 99 hours

T 11.85 Course: Digitalization of Products, Services & Production [T-MACH-108491]

Responsible: Dr.-Ing. Bernd Pätzold
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102613 - Major Field: Lifecycle Engineering

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

Events					
SS 2019	2122310	Digitalization of Products, Services & Production	2 SWS	Seminar (S)	Pätzold
WS 19/20	2122310	Digitalization of Products, Services & Production	2 SWS	Seminar (S)	Pätzold

Competence Certificate
Assessment of another type. Two presentations in team work and two written compositions. Grading: each composition 1/6 and each presentation 2/3.

Prerequisites
none

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

V Digitalization of Products, Services & Production

Seminar (S)

2122310, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content

- Digitalization of products, services and production in the context of Industry 4.0 .
- Key drivers for ongoing digitalization and their impact on future product development and manufacturing.
- Methods and procedures to design the according transformation process.
- Intensive group discussions of use-case scenarios using practical examples from the industry.

V Digitalization of Products, Services & Production

Seminar (S)

2122310, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content

- Digitalization of products, services and production in the context of Industry 4.0 .
- Key drivers for ongoing digitalization and their impact on future product development and manufacturing.
- Methods and procedures to design the according transformation process.
- Intensive group discussions of use-case scenarios using practical examples from the industry.

T 11.86 Course: Dimensioning and Optimization of Power Train System [T-MACH-105536]

Responsible: Prof. Dr.-Ing. Albert Albers
Dr.-Ing. Hartmut Faust
Dr. Eckhard Kirchner
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2146208	Dimensioning and Optimization of Power Train System	2 SWS	Lecture (V)	Faust
Exams					
SS 2019	7600001	Dimensioning and Optimization of Power Train System		Prüfung (PR)	Faust

Competence Certificate
oral exam (20 min)

Prerequisites
none

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

V Dimensioning and Optimization of Power Train System — Lecture (V)
2146208, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content

1. Architectures: conventional, hybrid and electrical transmissions
2. The gear as system in a vehicle
3. Components and power flow ofsynchromesh gears
4. Spur gears
5. Synchronization
6. Switching systems for vehicles with manual transmission
7. Actuators
8. Comfort aspects for manual transmissions
9. Torque converter
10. Planetary sets
11. Power conversion in automatic transmissions
12. Continuously variable transmission systems
13. Differentials and components for power split
14. Drive train for commercial vehicles
15. Gears and electrical machines for electro mobility

Workload
regular attendance: 21 h

self-study: 99 h

T 11.87 Course: Do it! – Service-Learning for prospective mechanical engineers [T-MACH-106700]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102824 - Key Competences

Type	Credits	Recurrence	Version
Completed coursework	2	Each winter term	1

Events					
WS 19/20	2109039	Do it! – Service-Learning for prospective mechanical engineers	2 SWS	Seminar (S)	Deml

Competence Certificate
Active and regular participation (compulsory attendance) in all appointments; no marking.

Prerequisites
Timely enrollment in ILIAS; limited number of participants.

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

V Do it! – Service-Learning for prospective mechanical engineers

Seminar (S)

2109039, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
The course combines university learning with social engagement. The students leave the well-known academic working conditions and apply engineering skills (such as the ergonomic workplace design) within a social institution.

The course will take place every two weeks with each session lasting three hours. A part of the course will not be held at KIT, but at a workshop for persons with disabilities.

1) Introductory session

Technical and generic preparation of the work assignment

2) Work assignment (3 sessions)

Getting to know the working conditions in a workshop for persons with disabilities and conducting a work analysis in small groups

3) Interim review session

Sharing about the experiences

4) Implementation phase (2 sessions)

Implementing improvement measures concerning workplace/-process design in small groups

5) Evaluation session

Evaluating and reflecting as well as transfering and integrating the new experiences in their student and working life

Learning target:

The aim of this course is to enable students to get to know different social living and working conditions (such as a workshop for persons with disabilities), to engage in society as prospective mechanical engineers, and in doing so to develop their personality.

The overall goal is to learn by service for people, which again is an important factor for client-oriented behavior. This kind of experience and action oriented learning by social engagement is also called “service-learning”. This is supposed to encourage students’ willingness to change their perspective and to achieve some level of understanding for other living and working conditions in order to enhance their social skills such as empathy, communication skills, individual initiative, and conflict management as well as to support self-organized learning.

This course is carried out in cooperation with external partners; the concept also exists at other universities *(http://www.agentur-mehrwert.de/de/hochschulen/do-it-studierendenprojekte.html).*

Literature
Course material will be provided in ILIAS.

T 11.88 Course: Drive Systems and Possibilities to Increase Efficiency [T-MACH-105451]

Responsible: Dr.-Ing. Hans-Peter Kollmeier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	2	Each winter term	1

Competence Certificate
Oral examination, time duration 30 min., no aids

Prerequisites
none

T 11.89 Course: Drive Train of Mobile Machines [T-MACH-105307]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Marco Wydra

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102630 - Major Field: Mobile Machines

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2113077	Drive Train of Mobile Machines	2 SWS	Lecture (V)	Geimer, Herr
WS 19/20	2113078	Übung zu 'Antriebsstrang mobiler Arbeitsmaschinen'	1 SWS	Practice (Ü)	Geimer, Herr
Exams					
SS 2019	76-T-MACH-105307	Drive Train of Mobile Machines		Prüfung (PR)	Geimer

Competence Certificate
The final assessment will be an oral examination (20 min) taking place during the recess period. The examination will be offered in ervery semester and can be repeated at any regular examination date.

Prerequisites
none

Recommendation

- General principles of mechanicals engineering
- Basic knowledge of hydraulics
- Interest in mobile machinery

Annotation
At the end of the lecture, participants can explain the structure and function of all discussed drive trains of mobile machines. They can analyze complex gearbox schematics and synthesize simple transmission functions using rough calculations.

Content:

In this course the different drive trains of mobile machinery will be discussed. The focus of this course is:

- mechanical gears
- torque converter
- hydrostatic drives
- power split drives
- electrical drives
- hybrid drives
- axles
- terra mechanics

Media: projector presentation

Literature: Download of lecture slides from ILIAS. Further literature recommendations during lectures.

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

V **Drive Train of Mobile Machines** **Lecture (V)**
2113077, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

projector presentation

Learning Content
In this course will be discussed the different drive train of mobile machinerys. The fokus of this course is:
- improve knowledge of fundamentals
- mechanical gears
- torque converter
- hydrostatic drives
- continuous variable transmission
- eletrical drives
- hybrid drives
- axles
- terra mechanic

Workload

- regular attendance: 21 hours
- self-study: 89 hours

Literature
download of scriptum via ILIAS

T 11.90 Course: Dynamics of the Automotive Drive Train [T-MACH-105226]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Oral examination	5	Each winter term	1

Events					
WS 19/20	2163111	Dynamics of the Automotive Drive Train	2 SWS	Lecture (V)	Fidlin
WS 19/20	2163112	Übungen zu Dynamik des Kfz-Antriebsstrangs	2 SWS	Practice (Ü)	Fidlin, Yüzbasioglu

Competence Certificate
Oral examination, 30 min.

Prerequisites
none

Recommendation
Powertrain Systems Technology A: Automotive SystemsMachine DynamicsVibration Theory

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

V Dynamics of the Automotive Drive Train

Lecture (V)

2163111, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content

- Main components of the vehicle powertrain and their modelling
- Typical driving situations
- Problemoriented models for particular driving situations
- System analysis and optimization with respect to dynamic behavior

Workload
time of attendance: 39 h
self-study: 201 h

Literature

- Dresig H. Schwingungen mechanischer Antriebssysteme, 2. Auflage, Springer, 2006
- Pfeiffer F., Mechanical System Dynamics, Springer, 2008
- Laschet A., Simulation von Antriebssystemen:Modellbildung der Schwingungssysteme und Beispiele aus der Antriebstechnik, Springer, 1988

T 11.91 Course: Electric Rail Vehicles [T-MACH-102121]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102641 - Major Field: Rail System Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114346	Electric Rail Vehicles	2 SWS	Lecture (V)	Gratzfeld
Exams					
SS 2019	76-T-MACH-102121	Electrical Railway Traction Systems		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-102121	Electric Rail Vehicles		Prüfung (PR)	Gratzfeld

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

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

V Electric Rail Vehicles
2114346, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

All slides are available for download (Ilias-platform).

Notes

1. Introduction: history of electric traction in railway vehicles, economic impact
2. Wheel-rail-contact: carrying of vehicle mass, adhesion, current return
3. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
4. Electric drives: purpose of electric drive and basic configurations, traction motors (induction machine, synchronous machine with permanent magnets), drives for vehicles at dc and ac lines, drives for vehicle without contact wire, hybrids, conventional drives for existing vehicles
5. Train control management system: definitions, networks, bus systems, components, examples
6. Vehicle concepts: modern vehicle concepts for mass transit and electric main line
7. Traction power supply: dc and ac networks, energy management, design aspects

Learning Content

1. Introduction: history of electric traction in railway vehicles, economic impact
2. Wheel-rail-contact: carrying of vehicle mass, adhesion, current return
3. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
4. Electric drives: traction motors, power conversion, drives for vehicles at dc and ac lines, dieselelectric vehicles, multi system vehicles, axle drives, transmission of tractive effort to the rails
5. Train control management system: definitions, networks, bus systems, components, examples
6. Vehicle concepts: modern vehicle concepts for mass transit and electric main line
7. Traction power supply: networks, substations, inductive power supply, energy management

Workload

Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature

A bibliography is available for download (Ilias-platform).

T 11.92 Course: Electrical Engineering for Business Engineers, Part II [T-ETIT-100534]

Responsible: Dr. Wolfgang Menesklou
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102739 - Fundamentals and Methods of Automotive Engineering

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	1

Events					
SS 2019	2304224	Elektrotechnik II für Wirtschaftsingenieure	3 SWS	Lecture (V)	Menesklou
Exams					
SS 2019	7304224	Electrical Engineering for Business Engineers, Part II		Prüfung (PR)	Menesklou

T 11.93 Course: Elements and Systems of Technical Logistics [T-MACH-102159]

Responsible: Georg Fischer
Dr.-Ing. Martin Mittwollen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102618 - Major Field: Production Technology
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2117096	Elements and systems of Technical Logistics	3 SWS	Lecture / Practice (VÜ)	Mittwollen, Fischer
Exams					
SS 2019	76-T-MACH-102159	Elements and Systems of Technical Logistics		Prüfung (PR)	Mittwollen

Competence Certificate
The assessment consists of an oral exam (20min) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

Recommendation
Knowledge out of Basics of Technical Logistics (T-MACH-102163) preconditioned

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

V Elements and systems of Technical Logistics

Lecture / Practice (VÜ)

2117096, WS 19/20, 3 SWS, Language: German, Open in study portal

Learning Content

- material flow systems and their (conveying) technical components
- mechanical behaviour of conveyors;
- structure and function of conveyor machines; elements of intralogistics (belt conveyor, racks, automatic guided vehicles, fan-in, bifurcation, and etc.)
- sample applications and calculations in addition to the lectures inside practical lectures

Annotation
Knowledge out of **Basics of Technical Logistics** preconditioned

Workload
presence: 36h

rework: 84h

Literature
recommendations during lectures

T 11.94 Course: Elements and Systems of Technical Logistics - Project [T-MACH-108946]

Responsible: Georg Fischer
Dr.-Ing. Martin Mittwollen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Examination of another type	2	Each winter term	1

Events					
WS 19/20	2117097	Elements and systems of Technical Logistics - project	SWS	Project (PRO)	Mittwollen, Fischer
Exams					
SS 2019	76-T-MACH-108946	Elements and Systems of Technical Logistics - Project		Prüfung (PR)	Mittwollen

Competence Certificate
Presentation of performed project and defense (30min) according to $4 (2), No. 3 of the examination regulation

Prerequisites
T-MACH-102159 (Elements and Systems of Technical Logistics) must have been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102159 - Elements and Systems of Technical Logistics must have been started.

Recommendation
Knowledge out of Basics of Technical Logistics (T-MACH-102163) preconditioned

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

V Elements and systems of Technical Logistics - project

Project (PRO)

2117097, WS 19/20, SWS, Language: German, Open in study portal

Description
Media:

supplementary sheets,presentations, blackboard

Learning Content

- mechanical behaviour of conveyors;
- structure and function of conveyor machines;
- elements of intralogistics (belt conveyor, racks, automatic guided vehicles, fan-in, bifurcation, and etc.)
- sample applications and calculations in addition to the lectures inside practical lectures
- Self manufacturing of a project report to recesses the topic.

Annotation
Knowledge out of **Basics of Technical Logistics (LV 2117095)** preconditioned

T 11.95 Course: Energy and Indoor Climate Concepts [T-ARCH-107406]

Responsible: Prof. Andreas Wagner
Organisation: KIT Department of Architecture
Part of: M-MACH-102648 - Major Field: Energy Technology for Buildings

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

Events					
SS 2019	1720970	Energy and Indoor Climate Concepts	3 SWS	Lecture (V)	Wagner
Exams					
SS 2019	7000764	Energy and Indoor Climate Concepts		Prüfung (PR)	Wagner

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

V Energy and Indoor Climate Concepts

1720970, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Notes
The students will become familiar with concepts and technologies of energy-efficient building. Topics like heat protection, passive solar energy use, ventilation systems and passive cooling are addressed. New ways of renewable energy supply show the path towards climate-neutral buildings. On the basis of examples from practice, energy and indoor climate concepts for different buildings types are investigated in detail and analyzed with regard to presented performance criteria. In addition, an excursion is offered. In terms of project work, individual design projects are examined with regard to their energy performance. For qualification targets see module handbook.

Appointment: Tue 9:45 - 11:15, 20.40, R 240

First Meeting: 23.04.2019, 11:15, 20 40, R 240

Examination: 14.08.2019

Number of Participants: 10

T 11.96 Course: Energy Conversion and Increased Efficiency in Internal Combustion Engines [T-MACH-105564]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2133121	Energy Conversion and Increased Efficiency in Internal Combustion Engines	2 SWS	Lecture (V)	Koch
Exams					
SS 2019	76-T-MACH-105564	Energy Conversion and Increased Efficiency in Internal Combustion Engines		Prüfung (PR)	Koch, Kubach
WS 19/20	76-T-MACH-105564	Energy Conversion and Increased Efficiency in Internal Combustion Engines		Prüfung (PR)	Koch

Competence Certificate
oral exam, 25 minutes, no auxillary means

Prerequisites
none

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

V Energy Conversion and Increased Efficiency in Internal Combustion Engines

Lecture (V)

2133121, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
1. Introduction
2. Thermodynamics of combustion engines
3. Fundamentals
4. gas exchange
5. Flow field
6. Wall heat losses
7. Combustion in gasoline engines
8. Pressure Trace Analysis
9. Combustion in Diesel engines
10. Waste heat recovery

Learning Content

1. Introduction
2. Thermodynamics of combustion engines
3. Fundamentals
4. gas exchange
5. Flow field
6. Wall heat losses
7. Combustion in gasoline engines
8. Pressure Trace Analysis
9. Combustion in Diesel engines
10. Waste heat recovery

Workload

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

T 11.97 Course: Energy demand of buildings – fundamentals and applications, with building simulation exercises [T-MACH-105715]

Responsible: Dr. Ferdinand Schmidt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102648 - Major Field: Energy Technology for Buildings

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2019	2158203	Energy demand of buildings – fundamentals and applications, with building simulation exercises	4 SWS	Lecture / Practice (VÜ)	Schmidt
Exams					
WS 19/20	76-T-MACH-105715	Energy demand of buildings – fundamentals and applications, with building simulation exercises		Prüfung (PR)	Schmidt

Competence Certificate
oral exam, 30 minutes

Prerequisites
none

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

V Energy demand of buildings – fundamentals and applications, with building simulation exercises

Lecture / Practice (VÜ)

2158203, SS 2019, 4 SWS, Language: German, Open in study portal

Notes

- Selected topics of building physics regarding energy demand of buildings for heating and cooling
- Occupants' comfort in buildings
- Ventilation demand and ventilation concepts
- The passive house concept
- Passive use of solar energy in buildings
- Passive systems / concepts for cooling of buildings
- Exergetic evaluation of building systems
- Heat transfer systems to rooms for heating and cooling, "low-ex" systems
- Numerical methods in building simulation
- Generation of load series, simulation of technical building equipment

Learning outcomes:

The students know the influencing factors on the energy demand of buildings. They know the requirements and prerequisites for low energy and passive houses. They are familiar with methods for setting up energy balances for buildings and the relevant technical building equipment. Students are able to judge under which circumstances zero-energy or plus-energy buildings (with respect to the annual primary energy balance) are attainable. They know the requirements and criteria for occupants' comfort in buildings and they are able to estimate the influence of different renovation and retrofit measures on the energy demand and occupants' comfort. They know use cases and limits of different heat transfer systems for heating and cooling of rooms and are familiar with low exergy concepts for building energy systems.
Through integrated computer exercises, students learn to set up energy models of buildings, perform simulations and sensitivity analysis using these models and to evaluate and present their results.

Exam conditions:

- Project work as prerequisite for oral exam (solution of assigned building simulation task, including presentation in front of class)
- Mode of examination: oral (30 min.)
- Conditions: Cannot be combined with the following courses:
- Building Simulation [2157109]

Learning Content

- Selected topics of building physics regarding energy demand of buildings for heating and cooling
- Occupants' comfort in buildings
- Ventilation demand and ventilation concepts
- The passive house concept
- Passive use of solar energy in buildings
- Passive systems / concepts for cooling of buildings
- Exergetic evaluation of building systems
- Heat transfer systems to rooms for heating and cooling, "low-ex" systems
- Numerical methods in building simulation
- Generation of load series, simulation of technical building equipment

Literature

same as in German, no English version of book by Pehnt (ed.) available)

T 11.98 Course: Energy Efficient Intralogistic Systems [T-MACH-105151]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102618 - Major Field: Production Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102629 - Major Field: Logistics and Material Flow Theory
M-MACH-102630 - Major Field: Mobile Machines
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2117500	Energy efficient intralogistic systems	2 SWS	Lecture (V)	Braun, Schönung
Exams					
SS 2019	76-T-MACH-105151	Energy Efficient Intralogistic Systems		Prüfung (PR)	Braun

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” should be known.

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

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

V Energy efficient intralogistic systems

Lecture (V)

2117500, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:
presentations, black board

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

Learning Content
The main focuses of the course are:

- green supply chain
- processes in Intralogistic systems
- evaluation of energy consumption of conveyors
- modeling of conveying systems
- methods for energy savings
- approaches for energy efficiency increasing of continuous and discontinuous conveyors
- dimensioning energy efficient drives
- new approaches for resource efficient conveying systems.

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

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

Literature
None.

T 11.99 Course: Energy Market Engineering [T-WIWI-107501]

Responsible: Prof. Dr. Christof Weinhardt
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104323 - Major Field: Innovation and Entrepreneurship

Type	Credits	Recurrence	Version
Written examination	4,5	Each summer term	1

Events					
SS 2019	2540464	Energy Market Engineering	2 SWS	Lecture (V)	Weinhardt, Staudt
SS 2019	2540465	Übung zu Energy Market Engineering	1 SWS	Practice (Ü)	Staudt, vom Scheidt
Exams					
SS 2019	79852	Energy Market Engineering		Prüfung (PR)	Weinhardt

Competence Certificate
The assessment consists of a written exam (60 min) (according to §4(2), 1 of the examination regulations). By successful completion of the exercises (§4 (2), 3 SPO 2007 respectively §4 (3) SPO 2015) a bonus can be obtained. If the grade of the written exam is at least 4.0 and at most 1.3, the bonus will improve it by one grade level (i.e. by 0.3 or 0.4).

Prerequisites
None

Recommendation
None

Annotation
Former course title until summer term 2017: T-WIWI-102794 "eEnergy: Markets, Services, Systems".

The lecture has also been added in the IIP Module *Basics of Liberalised Energy Markets*.

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

V Energy Market Engineering
2540464, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
This lecture discusses different design options for electricity markets. We will focus on different approaches of nodal and zonal pricing as well as single price mechanisms and capacity markets. After a short recap of German and European market designs, the different design options will be discussed scientifically and with the help of examples. Furthermore, we will evaluate alternative market design options like microgrids. Besides the fundamental functioning of those markets, we will introduce and discuss methodological knowledge to evaluate market design options.

Annotation
The lecture has also been added in the IIP Module *Basics of Liberalised Energy Markets*.

Workload
The total workload for this course is approximately 135.0 hours. For further information see German version.

Literature

- Erdmann G, Zweifel P. *Energieökonomik, Theorie und Anwendungen*. Berlin Heidelberg: Springer; 2007.
- Grimm V, Ockenfels A, Zoettl G. Strommarktdesign: Zur Ausgestaltung der Auktionsregeln an der EEX *. *Zeitschrift für Energiewirtschaft*. 2008:147-161.
- Stoft S. *Power System Economics: Designing Markets for Electricity*. IEEE; 2002.,
- Ströbele W, Pfaffenberger W, Heuterkes M. *Energiewirtschaft: Einführung in Theorie und Politik*. 2nd ed. München: Oldenbourg Verlag; 2010:349.

T 11.100 Course: Energy Storage and Network Integration [T-MACH-105952]

Responsible: Dr.-Ing. Wadim Jäger
Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102648 - Major Field: Energy Technology for Buildings

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189487	Energy Storage and Grid Integration	2 SWS	Lecture (V)	Jäger, Stieglitz
Exams					
SS 2019	76-T-MACH-105952	Energiespeicher und Netzintegration		Prüfung (PR)	Jäger, Stieglitz
WS 19/20	76-T-MACH-105952	Energiespeicher und Netzintegration		Prüfung (PR)	Jäger, Stieglitz

Competence Certificate
oral exam, about 30 minutes

Prerequisites
The courses T-MACH-105952 Energiespeicher und Netzintegration and T-ETIT-104644 - Energy Storage and Network Integration can not be combined.

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

V Energy Storage and Grid Integration

2189487, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
The lecture provides an overview of the different storage types and their fundamental integration into the power supply grid.

Thereby, within the scope of this lecture, the necessity and the motivation for converting and storing energy will be given. Starting from the definition of fundamental terms different physical and chemical storage types along with their theoretical and practical basis are described. In particular, the decoupling of energy production and energy consumption, and the provision of different energy scales (time, power, density) will be discussed. Furthermore, the challenge of energy transport and re-integration into the different grid types is considered.

Students understand the different types of energy storage and apply their knowledge for the selection and principal dimensioning of relevant energy storage tasks.

Furthermore, students can reflect the state-of-the-art of most important energy storage types, their fundamental characterisitics and viability at given boundary conditions and they are enabled to elaborate and apply basic integration issues dependent on the grid structure for the different network types.

Oral exam, duration approximately 30 min, tools: non

Learning Content
The lecture provides an overview of the different storage types and their fundamental integration into the power supply grid.

Thereby, within the scope of this lecture, the necessity and the motivation for converting and storing energy will be given. Starting from the definition of fundamental terms different physical and chemical storage types along with their theoretical and practical basis are described. In particular, the decoupling of energy production and energy consumption, and the provision of different energy scales (time, power, density) will be discussed. Furthermore, the challenge of energy transport and re-integration into the different grid types is considered.

T 11.101 Course: Energy Systems I: Renewable Energy [T-MACH-105408]

Responsible: Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102643 - Major Field: Fusion Technology
M-MACH-102648 - Major Field: Energy Technology for Buildings

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	2129901	Energy Systems I - Renewable Energy	3 SWS	Lecture (V)	Dagan
Exams					
SS 2019	76-T-MACH-105408	Energy Systems I: Renewable Energy		Prüfung (PR)	Dagan, Stieglitz
WS 19/20	76-T-MACH-105408	Energy Systems I: Renewable Energy		Prüfung (PR)	Dagan

Competence Certificate
oral exam, 1/2 hour

Prerequisites
none

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

V Energy Systems I - Renewable Energy
2129901, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture (V)

Notes
The course deals with fundamental aspects of renewable energies.

1. The first part deals with the basic concepts of absorbing solar beans, in an efficient manner accounting for the minimization of heat losses. In this context, selective topics on thermodynamics as well as fluid dynamics are introduced. In the second part few applications are discussed and optimizations techniques of solar collectors construction and their heat transfer are presented.
2. The use of solar energy as a source for heat generation is followed by the idea of electricity generation. Introductive aspects of Photovoltaic technologies are illuminated.
3. The last part presents additional regenerative energy sources such as wind and geothermal energy.

The student knows the principles of the feasibility of energy gain by means of renewable energies, in particular the solar energy.

regular attendance: 34 hours
self-study: 146 hours

Oral examination – as an elective course 30 minutes, in combination with Energiesysteme-II or other courses within the energy courses, as a major course 1 hour

Learning Content
The course deals with fundamental aspects of renewable energies.

1. The first part deals with the basic concepts of absorbing solar beans, in an efficient manner accounting for the minimization of heat losses. In this context, selective topics on thermodynamics as well as fluid dynamics are introduced. In the second part few applications are discussed and optimizations techniques of solar collectors construction and their heat transfer are presented.
2. The use of solar energy as a source for heat generation is followed by the idea of electricity generation. Introductive aspects of Photovoltaic technologies are illuminated.
3. The last part presents additional regenerative energy sources such as wind and geothermal energy.

Workload
regular attendance: 34 hours
self-study: 146 hours

T 11.102 Course: Energy systems II: Reactor Physics [T-MACH-105550]

Responsible: Dr. Aurelian Florin Badea
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102608 - Major Field: Nuclear Energy

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2130929	Energy systems II: Reactor Physics	2 SWS	Lecture (V)	Badea
Exams					
SS 2019	76-T-MACH-105550	Energy Systems II: Reactor Physics		Prüfung (PR)	Badea
WS 19/20	76-T-MACH-105550	Energy Systems II: Reactor Physics		Prüfung (PR)	Badea

Competence Certificate
oral exam, 20 min

Prerequisites
none

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

V Energy systems II: Reactor Physics

Lecture (V)

2130929, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
nuclear fission & fusion,

radioactive decay, neutron excess, fission, fast and
thermal neutrons, fissile and fertile nuclei,

neutron flux, cross section, reaction rate, mean free path,
chain reaction, critical size, moderation,

reactor dynamics,

transport- and diffusion-equation for the neutron flux distribution,
power distributions in reactor,

one-group and two-group theories,

light-water reactors,

reactor safety,

design of nuclear reactors,

breeding processes,

nuclear power systems of generation IV

Literature
Dieter Schmidt, Reaktortechnik, Band 1: Grundlagen, ISBN 3 7650 2003 6
Dieter Schmidt, Reaktortechnik, Band 2: Anwendungen, ISBN 3 7650 2004 4

T 11.103 Course: Engine Laboratory [T-MACH-105337]

Responsible: Dr.-Ing. Uwe Wagner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2134001	Engine Laboratory	2 SWS	Practical course (P)	Wagner
Exams					
SS 2019	76-T-MACH-105337	Engine Laboratory		Prüfung (PR)	Koch

Competence Certificate
written documentation of every experiment, certificate of successful attendance, no grading

Prerequisites
none

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

V Engine Laboratory
2134001, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
5 engine experiments in up-to-date development projects

Workload
regular attendance: 40 hours
self-study: 80 hours

Literature
Description of experiments

T 11.104 Course: Engine Measurement Techniques [T-MACH-105169]

Responsible: Dr.-Ing. Sören Bernhardt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102624 - Major Field: Information Technology
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2134137	Engine measurement techniques	2 SWS	Lecture (V)	Bernhardt
Exams					
WS 19/20	76-T-MACH-105169	Engine Measurement Techniques		Prüfung (PR)	Koch

Competence Certificate
oral examination, Duration: 0,5 hours, no auxiliary means

Prerequisites
none

Recommendation
T-MACH-102194 Combustion Engines I

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

V Engine measurement techniques
Lecture (V)

2134137, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Students get to know state-of-the-art measurement techniques for combustion engines. In particular basic techniques for measuring engine operating parameters such as torque, speed, power and temperature.

Possible measurement errors and abberations are discussed.

Furthermore techniques for measuring exhaust emissions, air/fuel ratio, fuel consumption as well as pressure indication for thermodynamic analysis are covered.

Workload
regular attendance: 21 hours
self-study: 100 hours

Literature

1. Grohe, H.:Messen an Verbrennungsmotoren
2. Bosch: Handbuch Kraftfahrzeugtechnik
3. Veröffentlichungen von Firmen aus der Meßtechnik
4. Hoffmann, Handbuch der Meßtechnik
5. Klingenberg, Automobil-Meßtechnik, Band C

T 11.105 Course: Engineer's Field of Work [T-MACH-105721]

Responsible: Prof. Dr. Martin Doppelbauer
Prof. Dr.-Ing. Peter Gratzfeld

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102824 - Key Competences

Type	Credits	Recurrence	Version
Completed coursework (written)	2	Each summer term	2

Events					
SS 2019	2114917	Engineer's Field of Work	2 SWS	Lecture (V)	Gratzfeld, Doppelbauer
Exams					
SS 2019	76-T-MACH-105721	Engineer's Field of Work		Prüfung (PR)	Gratzfeld, Doppelbauer
WS 19/20	76-T-MACH-105721	Engineer's Field of Work		Prüfung (PR)	Gratzfeld, Doppelbauer

Competence Certificate
written test

Duration: 30 minutes

result: passed / not passed

No tools or reference materials may be used during the exam.

Prerequisites
none

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

V Engineer's Field of Work
2114917, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

AFI1: Organization of Companies (Peter Gratzfeld)
organizational structure, organizational units, managerial structure, organization charts, project organization, relation between superior and staff, board of managing directors, management of the company, supervisory board, advisory board

AFI 2: Project Management (Peter Gratzfeld)
definition of project, project manager, project team, primary processes, supporting processes

AFI3: Personnel Development (Martin Doppelbauer)
applications, trainee programs, management career, professional career, career paths in companies, individual career planning, tasks of HR, manpower requirements planning, training, training-on-the-job, tools for human resource management, annual personnel talk, objective agreement

AFI4: Scheduling (Peter Gratzfeld)
Methods for detailed scheduling, network plans, critical path, Gantt-diagram, milestones

AFI5a/b: Development Processes (Martin Doppelbauer)
research, advance development, series development, product marketing, V-model, SPALTEN-model, technical specifications, requirement specifications, clarification, concept, draft, elaboration, validation, verification, documentation, FMEA

AFI6: Standards and Laws (Martin Doppelbauer)
importance of standards, German and international standardization systems, committees, certification

AFI7: Commercial Law (Martin Doppelbauer)
health protection, safety at work, environment protection, product liability, patents

AFI8: Calculation, Financial Statement (Peter Gratzfeld)
contract award estimate, project costing, unit cost, target costs, cost center accounting, cost recording, hourly rates, asset accounting, profit and loss statement

AFI9: Governance (Peter Gratzfeld)
principles of governance (accountability, responsibility, transparency, fairness), leadership (technical, commercial), reviews, boards, audits, codetermination, compliance

Learning Content

AFI1: Organization of Companies (Peter Gratzfeld)
organizational structure, organizational units, managerial structure, organization charts, project organization, relation between superior and staff, board of managing directors, management of the company, supervisory board, advisory board

AFI 2: Project Management (Peter Gratzfeld)
definition of project, project manager, project team, primary processes, supporting processes

AFI3: Personnel Development (Martin Doppelbauer)
applications, trainee programs, management career, professional career, career paths in companies, individual career planning, tasks of HR, manpower requirements planning, training, training-on-the-job, tools for human resource management, annual personnel talk, objective agreement

AFI4: Scheduling (Peter Gratzfeld)
Methods for detailed scheduling, network plans, critical path, Gantt-diagram, milestones

AFI5a/b: Development Processes (Martin Doppelbauer)
research, advance development, series development, product marketing, V-model, SPALTEN-model, technical specifications, requirement specifications, clarification, concept, draft, elaboration, validation, verification, documentation, FMEA

AFI6: Standards and Laws (Martin Doppelbauer)
importance of standards, German and international standardization systems, committees, certification

AFI7: Commercial Law (Martin Doppelbauer)
health protection, safety at work, environment protection, product liability, patents

AFI8: Calculation, Financial Statement (Peter Gratzfeld)
contract award estimate, project costing, unit cost, target costs, cost center accounting, cost recording, hourly rates, asset accounting, profit and loss statement

AFI9: Governance (Peter Gratzfeld)
principles of governance (accountability, responsibility, transparency, fairness), leadership (technical, commercial), reviews, boards, audits, codetermination, compliance

Workload

Regular attendance: 15 hours

Self-study: 15 hours

Test and preparation: 30 hours

Literature

All slides are available for download (Ilias-platform).

T 11.106 Course: Entrepreneurship [T-WIWI-102864]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104323 - Major Field: Innovation and Entrepreneurship

Type	Credits	Recurrence	Version
Written examination	3	Each term	1

Events					
SS 2019	2545001	Entrepreneurship	2 SWS	Lecture (V)	Terzidis, Mitarbeiter
Exams					
SS 2019	7900002	Entrepreneurship		Prüfung (PR)	Terzidis
SS 2019	7900192	Entrepreneurship		Prüfung (PR)	Terzidis

Competence Certificate
The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

Prerequisites
None

Recommendation
None

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

V Entrepreneurship
2545001, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Description
This lecture, as an obligatory part of the module “Entrepreneurship”, introduces basic concepts of entrepreneurship. It approaches the individual steps of dynamic corporate development. The focus here is the introduction to methods for generating innovative business ideas, the translation of patents into business concepts and general principles of business planning.
Other topics are the design and use of service-oriented information systems for founders, technology management, business model generation and lean startup methods for the implementation of business ideas in the way of controlled experiments in the market.

Learning Content
This lecture, as an obligatory part of the module "Entrepreneurship", introduces basic concepts of entrepreneurship. It approaches the individual steps of dynamic corporate development. The focus here is the introduction to methods for generating innovative business ideas, the translation of patents into business concepts and general principles of financial planning.
Other topics are the design and use of service-oriented information systems for founders, technology management, business model generation and lean startup methods for the implementation of business ideas in the way of controlled experiments in the market.

Workload
The total workload for this course is approximately 90 hours. For further information see German version.

T 11.107 Course: Excercises - Fatigue of Welded Components and Structures [T-MACH-109304]

Responsible: Dr. Majid Farajian
Prof. Dr. Peter Gumbsch

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	1	Each winter term	1

Events					
WS 19/20	2181731	Fatigue of Welded Components and Structures	2 SWS	Block (B)	Farajian, Gumbsch

Competence Certificate
successful solving of all exercises

Prerequisites
none

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

V Fatigue of Welded Components and Structures

2181731, WS 19/20, 2 SWS, Language: German, Open in study portal

Block (B)

Notes
The lecture gives an introduction to the following topics:

- weld quality
- typical damages of welded joints
- evaluation of notches, defects and residual stresses
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics
- life cycle analysis
- post-treatment methods for an extented lifetime
- maintenance, reconditioning and repair

The student can

- describe the influence of welding induced notches, defects and residual stresses on component behavior
- explain the basics of numerical and experimental methods for the evaluation of statically or cyclically loaded welds explain and can apply them
- derive measures in order to increase the lifetime of structures with welded joints under cyclical load

preliminary knowlegde materials science and mechanics recommended

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

Exercise sheets are handed out regularly.

oral examination (ca. 30 min)

no tools or reference materials

Learning Content
The lecture gives an introduction to the following topics:

- weld quality
- typical damages of welded joints
- evaluation of notches, defects and residual stresses
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics
- life cycle analysis
- post-treatment methods for an extented lifetime
- maintenance, reconditioning and repair

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

Literature

1. D. Radaj, C.M. Sonsino and W. Fricke, Fatigue assessment of welded joints by local approaches, Second edition.Woodhead Publishing, Cambridge 2006.
2. FKM-Richtlinie, Bruchmechanischer Festigkeitsnachweis, Forschungskuratorium Maschinenbau, VDMA Verlag, 2009

T 11.108 Course: Exercices - Tribology [T-MACH-109303]

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

Part of: M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102637 - Major Field: Tribology
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Expansion	Version
Completed coursework	0	Each winter term	1 terms	1

Events					
WS 19/20	2181114	Tribology	5 SWS	Lecture / Practice (VÜ)	Dienwiebel, Scherge
Exams					
SS 2019	76-T-MACH-109303	Exercices - Tribology		Prüfung (PR)	Dienwiebel

Competence Certificate
successful solving of all exercises

Prerequisites
none

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

V Tribology

2181114, WS 19/20, 5 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, evironmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems
- evaluate the friction and wear behavior of tribological systems
- explain the effects of lubricants and their most important additives
- identify suitable approaches to optimize tribological systems
- explain the most important experimental methods for the measurement of friction and wear, and is able to use them for the characterisation of tribo pairs
- choose suitable methods for the evaluation of roughness and topography from the nm-scale to the mm-scale and is able to interpret the determined values in respect to their effect on the tribological behavior
- describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces

preliminary knowlegde in mathematics, mechanics and materials science recommended

regular attendance: 45 hours
self-study: 195 hours

oral examination (ca. 40 min)

no tools or reference materials

admission to the exam only with successful completion of the exercises

Learning Content

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, evironmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

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

Literature

1. Fleischer, G. ; Gröger, H. ; Thum: Verschleiß und Zuverlässigkeit. 1. Auflage. Berlin : VEB-Verlag Technik, 1980
2. Persson, B.J.N.: Sliding Friction, Springer Verlag Berlin, 1998
3. M. Dienwiebel, and M. Scherge, Nanotribology in automotive industry, In:Fundamentals of Friction and Wear on the Nanoscale; Editors: E. Meyer and E. Gnecco, Springer, Berlin, 2007.
4. Scherge, M., Shakhvorostov, D., Pöhlmann, K.: Fundamental wear mechanism of metals. Wear 255, 395–400 (2003)
5. Shakhvorostov, D., Pöhlmann, K., Scherge, M.: An energetic approach to friction, wear and temperature. Wear 257, 124–130 (2004)

T 11.109 Course: Exercises for Applied Materials Simulation [T-MACH-107671]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	2	Each summer term	2

Events					
SS 2019	2182614	Applied Materials Modelling	4 SWS	Lecture / Practice (VÜ)	Schulz, Gumbsch
Exams					
SS 2019	76-T-MACH-107671	Exercises for Applied Materials Simulation		Prüfung (PR)	Schulz

Competence Certificate
successful solving of all exercises

Prerequisites
none

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

V Applied Materials Modelling

2182614, SS 2019, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

black board, beamer, script, computer exercise

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

The student can

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

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

oral exam ca. 35 minutes

no tools or reference materials

admission to the exam only with successful completion of the exercises

Learning Content

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

Workload

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

Literature

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

T 11.110 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-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	2	Each winter term	3

Events					
WS 19/20	2193005	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	1 SWS	Practice (Ü)	Seifert, Smyrek, Ziebert
Exams					
SS 2019	76-T-MACH-107669	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria		Prüfung (PR)	Seifert

Competence Certificate
successful solving of all exercises

Prerequisites
none

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

V Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

Practice (Ü)

2193005, WS 19/20, 1 SWS, Language: German, Open in study portal

Notes
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.

Learning 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

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

Responsible: Dr.-Ing. Jens Gibmeier
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Completed coursework	2	Each winter term	3

Events					
WS 19/20	2174586	materials characterization	2 SWS	Lecture (V)	Schneider, Gibmeier
Exams					
SS 2019	76-T-MACH-107685	Exercises for Materials Characterization		Prüfung (PR)	Heilmaier, Gibmeier
WS 19/20	76-T-MACH-107685	Exercises for Materials Characterization		Prüfung (PR)	Heilmaier, Gibmeier

Competence Certificate
Regular attendance

Prerequisites
none

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

V materials characterization

Lecture (V)

2174586, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

learning objectives:
The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.
requirements:
none
workload:

The workload for the module "Materials Characterization" is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

Learning Content
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

Workload
The workload for the module "Materials Characterization" is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

Literature

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

Literature will be announced at the beginning of the lecture.

T 11.112 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Completed coursework	2	Each winter term	3

Events					
WS 19/20	2193004	Exercises for Solid State Reactions and Kinetics of Phase Transformations	1 SWS	Practice (Ü)	Franke, Ziebert

Competence Certificate
successful processing of exercises

Prerequisites
none

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

V Exercises for Solid State Reactions and Kinetics of Phase Transformations

2193004, WS 19/20, 1 SWS, Language: German, Open in study portal

Practice (Ü)

Notes
1. Fick's laws of diffusion

2. Calculation of diffusion coefficients

3. Diffusion and solidification

Recommendations: Lecture in Solid State Reactions and Kinetics of Phase Transformations; Basic course in materials science and engineering; physical chemistry

Reinforcement of the lecture by the solution of practical and lecture-relevant exercises

Learning Content
1. Fick's laws of diffusion

2. Calculation of diffusion coefficients

3. Diffusion and solidification

Workload
regular attendance: 14 hours

self-study: 46 hours

Literature
Lecture notes

T 11.113 Course: Experimental Dynamics [T-MACH-105514]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102614 - Major Field: Mechatronics
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Oral examination	5	Each summer term	1

Events					
SS 2019	2162225	Experimental Dynamics	3 SWS	Lecture (V)	Fidlin
SS 2019	2162228	Übungen zu Experimentelle Dynamik	2 SWS	Practice (Ü)	Fidlin, Aramendiz Fuentes

Competence Certificate
oral exam, 30 min.

Prerequisites
Can not be combined with Practical Training in Measurement of Vibrations (T-MACH-105373).

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105373 - Practical Training in Measurement of Vibrations must not have been started.

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

V Experimental Dynamics

2162225, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

1. Introduction
2. Measurement principles
3. Sensors as coopled multi-physical systems
4. Digital signal processing, measurements in frequency domain
5. Forced non-linear vibrations
6. Stability problems (Mathieu oscillator, friction induces vibrations)
7. Elementary rotor dynamics
8. Modal analysis

Annotation
The lectures will be accompanied by the laboratory experiments

Workload
time of attendance: 29 h
self-study: 121 h

T 11.114 Course: Experimental Fluid Mechanics [T-MACH-105512]

Responsible: Dr. Jochen Kriegseis
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102634 - Major Field: Fluid Mechanic
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2154446	Experimental Fluid Mechanics	2 SWS	Lecture (V)	Kriegseis
WS 19/20	2153530	Experimental Fluid Mechanics	2 SWS	Lecture (V)	Kriegseis
Exams					
SS 2019	76-T-MACH-105512	Experimental Fluid Mechanics		Prüfung (PR)	Kriegseis
WS 19/20	76-T-MACH-105512	Experimental Fluid Mechanics		Prüfung (PR)	Kriegseis

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

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

V Experimental Fluid Mechanics

2154446, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Slides, chalk board, overhead

Learning Content
This lecture focuses on experimental methods of fluid mechanics and their application to solve flow problems of practical relevance. In addition, measurement signals and data, obtained with the discussed measuring techniques, are evaluated, presented and discussed.

The lecture covers a selection of the following topics:

- measuring techniques and measureable quantities
- measurements in turbulent flows
- pressure measurements
- hot wire measurements
- optical measuring techniques
- error analysis
- scaling laws
- signal and data evaluation

Workload
regular attendance: 19,5 hours
self-study: 100,5 hours

Literature
Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Spurk, J.H.:Fluid Mechanics, Springer, 1997

V Experimental Fluid Mechanics

2153530, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Description
Media:

Slides, chalk board, overhead

Notes
The students can describe the relevant physical principles of experimental fluid mechanics. They are qualified to comparatively discuss the introduced measurement techniques. Furthermore, they are able to distinguish (dis-)advantages of the respective approaches. The students can evaluate and discuss measurment signal and data obtained with the common fluid mechanical measuring techniques.

This lecture focuses on experimental methods of fluid mechanics and their application to solve flow problems of practical relevance. In addition, measurement signals and data, obtained with the discussed measuring techniques, are evaluated, presented and discussed.

The lecture covers a selection of the following topics:

- measuring techniques and measureable quantities
- measurements in turbulent flows
- pressure measurements
- hot wire measurements
- optical measuring techniques
- error analysis
- scaling laws
- signal and data evaluation

Learning Content
This lecture focuses on experimental methods of fluid mechanics and their application to solve flow problems of practical relevance. In addition, measurement signals and data, obtained with the discussed measuring techniques, are evaluated, presented and discussed.

The lecture covers a selection of the following topics:

- measuring techniques and measureable quantities
- measurements in turbulent flows
- pressure measurements
- hot wire measurements
- optical measuring techniques
- error analysis
- scaling laws
- signal and data evaluation

Workload
regular attendance: 19,5 hours
self-study: 100,5 hours

Literature
Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Spurk, J.H.:Fluid Mechanics, Springer, 1997

T 11.115 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-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	2

Events					
WS 19/20	2173560	Welding Lab Course, in groupes	3 SWS	Practical course (P)	Dietrich, Schulze

Competence Certificate
Certificate to be issued after evaluation of the lab class report.

Prerequisites
Certtificate of attendance for Welding technique (The participation in the course Welding Technology I/II is assumed.).

Annotation
The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

You need sturdy shoes and long clothes!

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

V Welding Lab Course, in groupes
Practical course (P)
2173560, WS 19/20, 3 SWS, Language: German, Open in study portal

Notes
The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

learning objectives: The students are capable to name a survey of current welding processes and their suitability for joining different metals. The students can evaluate the advantages and disadvantages of the individual procedures. The students have weld with different welding processes.

requirements:

Certificate to be issued after evaluation of the lab class report
You need sturdy shoes and long clothes!

workload:

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

Learning Content

Gas welding of steels with different weld geometries

Gas welding of cast iron, nonferrous metals

Brazing of aluminum

Electric arc welding with different weld geometries

Gas welding according to the TIG, MIG and MAG procedures

Annotation

The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

You need sturdy shoes and long clothes!

Workload

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

Literature

distributed during the lab attendance

T 11.116 Course: Experimental techniques in thermo- and fluid-dynamics [T-MACH-106373]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102635 - Major Field: Engineering Thermodynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190920	Experimental Techniques in thermo- and fluid-dynamics	2 SWS	Lecture (V)	Cheng
Exams					
SS 2019	76-T-MACH-106373	Experimental techniques in thermo- and fluid-dynamics		Prüfung (PR)	Cheng

Competence Certificate
oral exam, duration 20 min

Prerequisites
none

T 11.117 Course: Fabrication Processes in Microsystem Technology [T-MACH-102166]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2143882	Fabrication Processes in Microsystem Technology	2 SWS	Lecture (V)	Bade
WS 19/20	2143882	Fabrication Processes in Microsystem Technology	2 SWS	Lecture (V)	Bade
Exams					
SS 2019	76-T-MACH-102166	Fabrication Processes in Microsystem Technology		Prüfung (PR)	Bade

Competence Certificate
Oral examination, 20 minutes

Prerequisites
none

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

V Fabrication Processes in Microsystem Technology
2143882, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

pdf files of presentation sheets

Learning Content
The lecture offers an advanced understanding of manufacturing processes in microsystem technology. Basic aspects of microtechnological processing will be introduced. With examples from semiconductor microfabrication and microsystem technology the base processing steps for conditioning and finishing, patterning, removal are imparted. Nano-patterning is covered is also included and the micro-nano interface is discussed. By the help of typical processing steps elementary mechanisms, process execution, and equipment are explained. Additionally quality control, process control and environmental topics are included

Literature
M. Madou
Fundamentals of Microfabrication

CRC Press, Boca Raton, 1997

W. Menz, J. Mohr, O. Paul

Mikrosystemtechnik für Ingenieure

Dritte Auflage, Wiley-VCH, Weinheim 2005

L.F. Thompson, C.G. Willson, A.J. Bowden
Introduction to Microlithography
2nd Edition, ACS, Washington DC, 1994

V **Fabrication Processes in Microsystem Technology** **Lecture (V)**
2143882, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

pdf files of presentation sheets

Learning Content
The lecture offers an advanced understanding of manufacturing processes in microsystem technology. Basic aspects of microtechnological processing will be introduced. With examples from semiconductor microfabrication and microsystem technology the base processing steps for conditioning and finishing, patterning, removal are imparted. Nano-patterning is covered is also included and the micro-nano interface is discussed. By the help of typical processing steps elementary mechanisms, process execution, and equipment are explained. Additionally quality control, process control and environmental topics are included

Literature
M. Madou
Fundamentals of Microfabrication

CRC Press, Boca Raton, 1997

W. Menz, J. Mohr, O. Paul

Mikrosystemtechnik für Ingenieure

Dritte Auflage, Wiley-VCH, Weinheim 2005

L.F. Thompson, C.G. Willson, A.J. Bowden
Introduction to Microlithography
2nd Edition, ACS, Washington DC, 1994

T 11.118 Course: Failure Analysis [T-MACH-105724]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102637 - Major Field: Tribology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2182572	Failure Analysis	2 SWS	Lecture (V)	Greiner, Schneider
Exams					
SS 2019	76-T-MACH-105724	Failure Analysis		Prüfung (PR)	Schneider
WS 19/20	76-T-MACH-105724	Failure Analysis		Prüfung (PR)	Schneider

Competence Certificate
oral examination, ca. 30 min

Prerequisites
none

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

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

V Failure Analysis
2182572, WS 19/20, 2 SWS, Open in study portal

Lecture (V)

Notes
Aim, procedure and content of examining failure

Examination methods

Types of failure:
Failure due to mechanical loads
Failure due to corrosion in electrolytes
Failure due to thermal loads
Failure due to tribological loads

Damage systematics

The students are able to discuss damage evaluation and to perform damage investigations. They know the common necessary investigation
methods and can regard failures considering load and material resistance. Furthermore they can describe and discuss the most important types of failure and damage appearance.

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

regular attendance: 21 hours
self-study: 99 hours

oral exam, duration: ca. 30 minutes
no notes

Learning Content
Aim, procedure and content of examining failure

Examination methods

Types of failure:
Failure due to mechanical loads
Failure due to corrosion in electrolytes
Failure due to thermal loads
Failure due to tribological loads

Damage systematics

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

Literature

1. G. Lange: Systematische Beurteilung technischer Schadensfälle, 6. Auflage, WILEY-VCH Verlag, 2014, ISBN 978-3-527-68316-1, In der KIT-BIB online verfügbar!
2. A. Neidel, et al.: Handbuch Metallschäden -- REM-Atlas und Fallbeispiele zur Ursachenanalyse und Vermeidung, 2. Auflage, Hanser Verlag, 2011, ISBN 978-3-446-42966-6
3. J. Grosch, et al.: Schadenskunde im Maschinenbau: Charakteristische Schadensursachen – Analyse und Aussagen von Schadensfällen, 6. Auflage, Expert-Verlag, 2014, ISBN 978-3-816-93172-0
4. E. Wendler-Kalsch, H. Gräfen: Korrosionsschadenkunde, Springer-Verlag, 1998, ISBN 3-540-63377-4

T 11.119 Course: Failure of Structural Materials: Deformation and Fracture [T-MACH-102140]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2181711	Failure of structural materials: deformation and fracture	3 SWS	Lecture / Practice (VÜ)	Gumbsch, Weygand

Competence Certificate
oral exam ca. 30 minutes

no tools or reference materials

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, mechanics and materials science

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

V Failure of structural materials: deformation and fracture

Lecture / Practice (VÜ)

2181711, WS 19/20, 3 SWS, Language: German, Open in study portal

Notes

1. Introduction
2. linear elasticity
3. classification of stresses
4. Failure due to plasticity
    - tensile test
    - dislocations
    - hardening mechanisms
    - guidelines for dimensioning
5. composite materials
6. fracture mechanics
    - hypotheses for failure
    - linear elasic fracture mechanics
    - crack resitance
    - experimental measurement of fracture toughness
    - defect measurement
    - crack propagation
    - application of fracture mechanics
    - atomistics of fracture

The student

- has the basic understanding of mechanical processes to explain the relationship between externally applied load and materials strength.
- can explain the foundation of linear elastic fracture mechanics and is able to determine if this concept can be applied to a failure by fracture.
- can decribe the main empirical materials models for deformation and fracture and can apply them.
- has the physical understanding to describe and explain phenomena of failure.

preliminary knowlegde in mathematics, mechanics and materials science recommended

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

The assessment consists of an oral examination (ca. 30 min) according to Section 4(2), 2 of the examination regulation.

Learning Content

1. Introduction
2. linear elasticity
3. classification of stresses
4. Failure due to plasticity
    - tensile test
    - dislocations
    - hardening mechanisms
    - guidelines for dimensioning
5. composite materials
6. fracture mechanics
    - hypotheses for failure
    - linear elasic fracture mechanics
    - crack resitance
    - experimental measurement of fracture toughness
    - defect measurement
    - crack propagation
    - application of fracture mechanics
    - atomistics of fracture

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

Literature

- Engineering Materials, M. Ashby and D.R. Jones (2nd Edition, Butterworth-Heinemann, Oxford, 1998); worth reading, relatively simple but comprehensive
- Mechanical Behavior of Materials, Thomas H. Courtney (2nd Edition, McGraw Hill, Singapur); classic on the mechanical behavior of materials, extensive and good
- Bruchvorgänge in metallischen Werkstoffen, D. Aurich (Werkstofftechnische Verlagsgesellschaft Karlsruhe), relatively simple but yet comprehensive overview of metallic materials

T 11.120 Course: Failure of Structural Materials: Fatigue and Creep [T-MACH-102139]

Responsible: Dr. Patric Gruber
Prof. Dr. Peter Gumbsch

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2181715	Failure of Structural Materials: Fatigue and Creep	2 SWS	Lecture (V)	Gruber, Gumbsch
Exams					
SS 2019	76-T-MACH-102139	Failure of Structural Materials: Fatigue and Creep		Prüfung (PR)	Gruber, Kraft, Gumbsch

Competence Certificate
oral exam ca. 30 minutes

no tools or reference materials

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, mechanics and materials science

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

V Failure of Structural Materials: Fatigue and Creep

Lecture (V)

2181715, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
1 Fatigue
1.1 Introduction
1.2 Statistical Aspects
1.3 Lifetime
1.4 Fatigue Mechanisms
1.5 Material Selection
1.6 Thermomechanical Loading
1.7 Notches and Shape Optimization
1.8 Case Study: ICE-Desaster

2 Creep
2.1 Introduction
2.2 High Temperature Plasticity
2.3 Phänomenological DEsciption of Creep
2.4 Creep Mechanisms
2.5 Alloying Effects

The student

- has the basic understanding of mechanical processes to explain the relationships between externally applied load and materials strength.
- can describe the main empirical materials models for fatigue and creep and can apply them.
- has the physical understanding to describe and explain phenomena of failure.
- can use statistical approaches for reliability predictions.
- can use its acquired skills, to select and develop materials for specific applications.

preliminary knowlegde in mathematics, mechanics and materials science recommended

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

The assessment consists of an oral examination (ca. 30 min) according to Section 4(2), 2 of the examination regulation.

Learning Content
1 Fatigue
1.1 Introduction
1.2 Statistical Aspects
1.3 Lifetime
1.4 Fatigue Mechanisms
1.5 Material Selection
1.6 Thermomechanical Loading
1.7 Notches and Shape Optimization
1.8 Case Study: ICE-Desaster

2 Creep
2.1 Introduction
2.2 High Temperature Plasticity
2.3 Phänomenological DEsciption of Creep
2.4 Creep Mechanisms
2.5 Alloying Effects

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

Literature

- Engineering Materials, M. Ashby and D.R. Jones (2nd Edition, Butterworth-Heinemann, Oxford, 1998); worth reading, relatively simple but comprehensive
- Mechanical Behavior of Materials, Thomas H. Courtney (2nd Edition, McGraw Hill, Singapur); classic on the mechanical behavior of materials, extensive and good
- Bruchvorgänge in metallischen Werkstoffen, D. Aurich (Werkstofftechnische Verlagsgesellschaft Karlsruhe), relatively simple but yet comprehensive overview of metallic materials
- Fatigue of Materials, Subra Suresh (2nd Edition, Cambridge University Press); standard work on fatigue, all classes of materials, extensive, for beginners and advanced student

T 11.121 Course: Fatigue of Metallic Materials [T-MACH-105354]

Responsible: Dr.-Ing. Stefan Guth
Dr. Karl-Heinz Lang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2173585	Fatigue of Metallic Materials	2 SWS	Lecture (V)	Guth, Lang
Exams					
SS 2019	76-T-MACH-105354	Fatigue of Metallic Materials		Prüfung (PR)	Lang, Guth
WS 19/20	76-T-MACH-105354	Fatigue of Metallic Materials		Prüfung (PR)	Lang, Guth

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Basic knowledge in Materials Science will be helpful.

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

V Fatigue of Metallic Materials
2173585, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

Introduction: some interesting cases of damage

Cyclic Stress Strain Behaviour

Crack Initiation

Crack Propagation

Lifetime Behaviour under Cyclic Loading

Fatigue of Notched Components

Influence of Residual Stresses

Structural Durability

learning objectives:

The students are able to recognise the deformation and the failure behaviour of metallic materials under cyclic loading and to assign it to the basic microstructural processes. They know the sequence and the development of fatigue damages and can evaluate the initiation and the growth of fatigue cracks.

The students can assess the cyclic strength behaviour of metallic materials and components both qualitatively and quantitatively and know the procedures for the assessment of single-stage, multistage and stochastic cyclical loadings. Furthermore, they can take into account the influence of residual stresses.

requirements:

none, basic knowledge in Material Science will be helpful

workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content

Introduction: some interesting cases of damage

Cyclic Stress Strain Behaviour

Crack Initiation

Crack Propagation

Lifetime Behaviour under Cyclic Loading

Fatigue of Notched Components

Influence of Residual Stresses

Structural Durability

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Lecture notes that include a list of current literature
will be distributed.

T 11.122 Course: Fatigue of Welded Components and Structures [T-MACH-105984]

Responsible: Dr. Majid Farajian
Prof. Dr. Peter Gumbsch

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Oral examination	3	Each winter term	1

Events					
WS 19/20	2181731	Fatigue of Welded Components and Structures	2 SWS	Block (B)	Farajian, Gumbsch

Competence Certificate
oral examination (ca. 30 min)

no tools or reference materials

Prerequisites
admission to the exam only with successful completion of the exercises [T-MACH-109304]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-109304 - Excercises - Fatigue of Welded Components and Structures must have been passed.

Recommendation
preliminary knowlegde materials science and mechanics

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

V Fatigue of Welded Components and Structures

2181731, WS 19/20, 2 SWS, Language: German, Open in study portal

Block (B)

Notes
The lecture gives an introduction to the following topics:

- weld quality
- typical damages of welded joints
- evaluation of notches, defects and residual stresses
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics
- life cycle analysis
- post-treatment methods for an extented lifetime
- maintenance, reconditioning and repair

The student can

- describe the influence of welding induced notches, defects and residual stresses on component behavior
- explain the basics of numerical and experimental methods for the evaluation of statically or cyclically loaded welds explain and can apply them
- derive measures in order to increase the lifetime of structures with welded joints under cyclical load

preliminary knowlegde materials science and mechanics recommended

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

Exercise sheets are handed out regularly.

oral examination (ca. 30 min)

no tools or reference materials

Learning Content
The lecture gives an introduction to the following topics:

- weld quality
- typical damages of welded joints
- evaluation of notches, defects and residual stresses
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics
- life cycle analysis
- post-treatment methods for an extented lifetime
- maintenance, reconditioning and repair

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

Literature

1. D. Radaj, C.M. Sonsino and W. Fricke, Fatigue assessment of welded joints by local approaches, Second edition.Woodhead Publishing, Cambridge 2006.
2. FKM-Richtlinie, Bruchmechanischer Festigkeitsnachweis, Forschungskuratorium Maschinenbau, VDMA Verlag, 2009

T 11.123 Course: FEM Workshop - Constitutive Laws [T-MACH-105392]

Responsible: Dr. Katrin Schulz
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	1

Events					
SS 2019	2183716	FEM Workshop -- Constitutive Laws	2 SWS	Block (B)	Schulz, Weygand

Competence Certificate
solving of a FEM problem

preparation of a report

preparation of a short presentation

Prerequisites
none

Recommendation
Engineering Mechanics; Advanced Mathematics; Introduction to Theory of Materials

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

V FEM Workshop -- Constitutive Laws

2183716, SS 2019, 2 SWS, Language: German, Open in study portal

Block (B)

Notes
The course repeats the fundamentals of the theory of materials. It leads to the characterization and classification of material behavior as well as the specification by adequate material models. Here we focus on elastic, viscoelastic, plastic, and viscoplastic deformation behavior. Introducing the finite element program ABAQUS, the students learn how to analyze the material models numerically. Therefore ABAQUS-own and continuative constitutive equations are chosen.

The student

- has the basic understanding of the materials theory and the classification of materials
- is able to independently generate numerical models using ABAQUS and can choose and apply adequate constitutive equations

Engineering Mechanics; Advanced Mathematics; Introduction to Theory of Materials recommended

regular attendance: 28 hours
self-study: 92 hours

Oral examination in the elective module MSc, otherwise no grading

solving of a FEM problem

preparation of a report

preparation of a short presentation

T 11.124 Course: Finite Difference Methods for Numerial Solution of Thermal and Fluid Dynamical Problems [T-MACH-105391]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153405	Finite Difference Methods for numerial solution of thermal and fluid dynamical problems	2 SWS	Lecture (V)	Günther
Exams					
SS 2019	76-T-MACH-105391	Finite Difference Methods for Numerial Solution of Thermal and Fluid Dynamical Problems		Prüfung (PR)	Günther

Competence Certificate
oral exam, Duration: 30 minutes

no auxiliary means

Prerequisites
none

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

V Finite Difference Methods for numerial solution of thermal and fluid dynamical problems

Lecture (V)

2153405, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
This lecture will be omitted until further.

The students can apply the most important difference schemes for the numerical solution of steady and transient problems which are typical for thermal and fluid flow problems. They are able to discuss the most relevant properties of difference schemes such as consistency, stability and convergence. Furthermore, they can estimate the order of the numerical error and non-appearance of numerical oscillations.

The students get a basic knowledge of relevant numerical algorithms and the use of them in commercial and open fluid flow codes.

The lecture initially presents an overview and then the most important difference schemes for the numerical solution of steady and transient problems which are typical for thermal and fluid flow problems. The most relevant properties of difference schemes at one side as consistency, stability and convergence, at the other side the order of the numerical error and non-appearance of numerical oscillations are described. Algorithms for the solution of coupled systems of equations, characteristic for fluid flow and thermal problems, are reviewed.

- Spatial and temporal discretization
- Properties of difference schemes
- Numerical stability, consistency, convergence
- Nonhomogeneous meshes
- Coupled and noninteracting calculation methods

Learning Content

The lecture initially presents an overview and then the most important difference schemes for the numerical solution of steady and transient problems which are typical for thermal and fluid flow problems. The most relevant properties of difference schemes at one side as consistency, stability and convergence, at the other side the order of the numerical error and non-appearance of numerical oscillations are described. Algorithms for the solution of coupled systems of equations, characteristic for fluid flow and thermal problems, are reviewed.

- Spatial and temporal discretization
- Properties of difference schemes
- Numerical stability, consistency, convergence
- Nonhomogeneous meshes
- Coupled and noninteracting calculation methods

Workload

regulare attendance: 21h

self-study: 100h

T 11.125 Course: Finite Element Workshop [T-MACH-105417]

Responsible: Prof. Dr. Claus Mattheck
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102602 - Major Field: Reliability in Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2182731	Finite Element Workshop	2 SWS	Block (B)	Weygand, Mattheck, Tesari

Competence Certificate
attendance certificate for participation in all course dates

Prerequisites
none

Recommendation
Continuum Mechanics

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

V Finite Element Workshop
2182731, SS 2019, 2 SWS, Language: German, Open in study portal

Block (B)

Notes
The students will learn the foundations of the FEM stress analysis and the optimization methode 'Zugdreiecke'.

The student can

- perform stress analysis for simple components using the commercial software package ANSYS
- utilise the method of the tensile triangle to optimize the shape of components with respect to stress distribution

Fundamentals of Continuum Mechanics are required.

regular attendance: 22,5 hours

certificate in case of regular attendance

Learning Content
The students will learn the foundations of the FEM stress analysis and the optimization methode 'Zugdreiecke'.

Workload
regular attendance: 22,5 hours

T 11.126 Course: Finite Volume Methods for Fluid Flow [T-MACH-105394]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2154431	Finite Volume Methods for Fluid Flow	2 SWS	Lecture (V)	Günther
Exams					
SS 2019	76-T-MACH-105394	Finite Volume Methods for Fluid Flow		Prüfung (PR)	Günther

Competence Certificate
oral exam, Duration: 30 minutes

no auxiliary means

Prerequisites
none

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

V Finite Volume Methods for Fluid Flow
Lecture (V)

2154431, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
Students can describe all fundamental aspcets of the finite volume methods, which form the basis for a number of different commerical CFD codes. Students become familiar with the basics of the generation of unstructured meshes.

The Finite Volume Method (=FVM) is nowadays of great interest, as it guarantees conservation of all relevant variables and as it can be used on nearly arbitrary meshes. By this it is a fundamental tool for numerical simulation of flows, which plays an ever growing role for construction and engineering and is the basis of several commercial or research codes as CFX, STAR-CCM+, FLUENT or OpenFOAM. The lecture is concerned with all aspects of FVM, mesh generation is also included. Newer developments as CVFEM (control volume based FEM) are described.

- Introduction
- Conservative schemes
- Finite volume method
- Analysis of FVM
- CVFEM as conservative FEM
- FVM for Navier-Stokes Equations
- Basics of mesh generation

Learning Content

The Finite Volume Method (=FVM) is nowadays of great interest, as it guarantees conservation of all relevant variables and as it can be used on nearly arbitrary meshes. By this it is a fundamental tool for numerical simulation of flows, which plays an ever growing role for construction and engineering and is the basis of several commercial or research codes as CFX, STAR-CCM+, FLUENT or OpenFOAM. The lecture is concerned with all aspects of FVM, mesh generation is also included. Newer developments as CVFEM (control volume based FEM) are described.

- Introduction
- Conservative schemes
- Finite volume method
- Analysis of FVM
- CVFEM as conservative FEM
- FVM for Navier-Stokes Equations
- Basics of mesh generation

Annotation

The lecture is recommended for students of mechanical, chemical or electrical engineering and is also of interest for people which are interested in FVM in a context other than fluid flow problems.

Workload

regulare attendance: 32 h

self-study: 88 h

T 11.127 Course: Flow Measurement Techniques [T-MACH-108796]

Responsible: Dr. Jochen Kriegseis
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	1

Events					
SS 2019	2155425	Flow Measurement Techniques	2 SWS	Practical course (P)	Kriegseis
WS 19/20	2155425	Flow Measurement Techniques	2 SWS	Practical course (P)	Kriegseis

Competence Certificate
Participation in at least 7 out of 9 events, successful initial colloquium prior to the respective measurements and submission of a significant report after every experiment

Prerequisites
none

Recommendation
The content of lecture "Experimental Fluid Mechanics" (T-MACH-105512)

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

V Flow Measurement Techniques
2155425, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Notes
The following flow measurement techniques are considered:

- wind tunnel techniques and estimation of turbulence intensity
- hot wire calibration an measzrement
- pressure measurements in air (around bodies)
- pressure measurements in water (Nikuradse diagram)
- Schlieren techniques
- Mach-Zehnder interferometry
- laser Doppler anemometry
- particle image velocimetry
- uncertainty estimation

The students can apply various flow measurements. They are capable to obtain, (post-)process and analyze flow data. Furthermore, the students can contrast advantages and disadvantages of the respective experimental approaches.

regular attendance: 30 hours
self-study: 90 hours

T 11.128 Course: Flow Simulations [T-MACH-105458]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

Events					
WS 19/20	2154447	Flow Simulations	2 SWS	Practical course (P)	Bruzzese, Frohnapfel, Mitarbeiter

Competence Certificate
ungraded homework and colloquium

Prerequisites
none

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

V Flow Simulations
2154447, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Description
Practical exercises

Notes
Flow Simulations with OpenFOAM(R)

- Basic elements of a simulation with OPENFOAM(R)
- Simulation of 'classic' incompressible, stationary/unstationary, laminar/turbulent (in RANS context) flows (special types of flows, e.g. reactive flows, multi-phase flows, magnetohydrodynamics, ... are not covered)
- Visualization of results
- Evaluation and interpretation of results
- Necessary basics of turbulence modelling with RANS models in OPENFOAM(R)
- Basics of the structure and the numerics of OPENFOAM(R) and possibilities for extending the software

(This offering is not approved or endorsed by OpenCFD Limited, producer and distributor of the OpenFOAMsoftware via www.openfoam.com, and owner of the OPENFOAM(R) and OpenCFD(R) trade marks. OPENFO-AM(R) is a registered trade mark of OpenCFD Limited, producer and distributor of the OpenFOAM software via www.openfoam.com.)

Learning Content
Flow Simulations with OpenFOAM(R)

- Basic elements of a simulation with OPENFOAM(R)
- Simulation of 'classic' incompressible, stationary/unstationary, laminar/turbulent (in RANS context) flows (special types of flows, e.g. reactive flows, multi-phase flows, magnetohydrodynamics, ... are not covered)
- Visualization of results
- Evaluation and interpretation of results
- Necessary basics of turbulence modelling with RANS models in OPENFOAM(R)
- Basics of the structure and the numerics of OPENFOAM(R) and possibilities for extending the software

Students are able to use the basic functionality of the open source software OPENFOAM(R) for simulating laminar and turbulent flows (in RANS context). They know the setup and the process of a fluid mechanical simulation with OPENFOAM(R). The students are able to visualize the results and to question the plausibility of the results. They are able to build simple block-structured meshes and meshes of more complex three-dimensional domains. The students are aware of the sensitivity of the results of a flow simulation (meshing, numerical settings, turbulence model).

Annotation
Block course with limited number of participants, registration in the secretary's office required. See details at **www.istm.kit.edu**

(This offering is not approved or endorsed by OpenCFD Limited, producer and distributor of the OpenFOAMsoftware via www.openfoam.com, and owner of the OPENFOAM(R) and OpenCFD(R) trade marks. OPENFO-AM(R) is a registered trade mark of OpenCFD Limited, producer and distributor of the OpenFOAM software via **www.openfoam.com**.)

Workload
regulare attendance: 30h

self-study: 90h

Literature
H. Ferziger, M. Peric, *Computational Methods for Fluid Dynamics*, Springer, 2008

11.129 Course: Flows and Heat Transfer in Energy Technology [T-MACH-105403]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102635 - Major Field: Engineering Thermodynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189911	Tutorial 'Flows and Heat Transfer in Energy Technology '	1 SWS	Practice (Ü)	Cheng, Mitarbeiter
Exams					
SS 2019	76-T-MACH-105403	Flows and Heat Transfer in Energy Technology		Prüfung (PR)	Cheng

Competence Certificate
oral exam, 20 min

Prerequisites
none

T 11.130 Course: Flows with Chemical Reactions [T-MACH-105422]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102634 - Major Field: Fluid Mechanic
M-MACH-102635 - Major Field: Engineering Thermodynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153406	Flows with chemical reactions	2 SWS	Lecture (V)	Class

Competence Certificate
oral exam, duration 30 minutes

Auxiliary none

Prerequisites
none

Recommendation
Fluid Mechanics (T-MACH-105207)

Mathematical Methods in Fluid Mechanics (T-MACH-105295)

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

V Flows with chemical reactions
Lecture (V)

2153406, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Black board

Notes
The students can describe flow scenarios, where a chemical reaktion is confined to a thin layer. They can choose simplifying approaches for the underlying chemistry and discuss the problems with focus on the fluid mechanic aspects. The students are able to solve simple problems analytically. Furthermore, they are qualified to discuss simplifications as relevant for an efficent numerical solution of complex problems.

In the lecture we mainly consider problems, where chemical reaktion is confined to a thin layer.
The problems are solved analytically or they are at least simplified allowing for efficent numerical
sollution procedures. We apply simplified chemistry and focus on the fluid mechanic aspects of the problems.

Learning Content
In the lecture we mainly consider problems, where chemical reaktion is confined to a thin layer.
The problems are solved analytically or they are at least simplified allowing for efficent numerical
sollution procedures. We apply simplified chemistry and focus on the fluid mechanic aspects of the problems.

Workload
regulare attendance: 22.5h

self-study: 99h

Literature
Lecture

Buckmaster, J.D.; Ludford, G.S.S.: Lectures on Mathematical Combustion, SIAM 1983

T 11.131 Course: Fluid Mechanics of Turbulent Flows [T-BGU-109581]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo- and Environmental Sciences
Part of: M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Expansion	Version
Oral examination	4	Each summer term	1 terms	1

Events					
SS 2019	6221806	Fluid Mechanics of Turbulent Flows	2 SWS	Lecture (V)	Uhlmann
Exams					
SS 2019	8240109581	Fluid Mechanics of Turbulent Flows		Prüfung (PR)	Uhlmann

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none

T 11.132 Course: Fluid Power Systems [T-MACH-102093]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Felix Pult

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102630 - Major Field: Mobile Machines
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2114093	Fluid Technology	2 SWS	Lecture (V)	Geimer, Pult
Exams					
SS 2019	76-T-MACH-102093	Fluid Power Systems		Prüfung (PR)	Geimer
WS 19/20	76T-MACH-102093	Fluid Power Systems		Prüfung (PR)	Geimer

Competence Certificate
The assessment consists of a writen exam (90 minutes) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
none

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

V Fluid Technology
2114093, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
In the range of hydrostatics the following topics will be introduced:

- Hydraulic fluids
- Pumps and motors
- Valves
- Accessories
- Hydraulic circuits.

In the range of pneumatics the following topics will be introduced:

- Compressors
- Motors
- Valves
- Pneumatic circuits.

Workload

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

Literature
Scritum for the lecture *Fluidtechnik*
Institute of Vehicle System Technology
downloadable

T 11.133 Course: Fluid-Structure-Interaction [T-MACH-105474]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Mark-Patrick Mühlhausen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2154401	Fluid-Structure-Interaction	2 SWS		Mühlhausen
Exams					
SS 2019	76-T-MACH-105474	Fluid-Structure-Interaction		Prüfung (PR)	Mühlhausen

Competence Certificate
oral exam 30 minutes

Prerequisites
none

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

V Fluid-Structure-Interaction
2154401, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
The lecture first introduces/recalls the fundamental governing equations that describe fluids and structures. After the characterization of the problem, the relevant equations are discussed and geometry and grid generation are treated. The resulting partial differential equations are transformed into an algebraic set of equations using different DFG and CSD methods and discretization schemes. Different methods for fluid structure coupling are introduced, where the resulting stability problem is treated in detail. Finally, the obtained result is critically examined in terms of errors and inaccuracy and verification and validation procedures are introduced.

The lecture includes an introduction to function of CFG-Programs and Matlab routines that are related to the theoretically discussed approaches.

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

See details at www.istm.kit.edu

Workload
regular attendance: 21.5h

self-studie: 99h

Literature
will be introduced during the lecture

T 11.134 Course: Foundations of Nonlinear Continuum Mechanics [T-MACH-105324]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102646 - Major Field: Applied Mechanics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2181720	Foundations of nonlinear continuum mechanics	2 SWS	Lecture (V)	Kamlah
Exams					
SS 2019	76-T-MACH-105324	Foundations of Nonlinear Continuum Mechanics		Prüfung (PR)	Kamlah

Competence Certificate
oral exam

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

V Foundations of nonlinear continuum mechanics

Lecture (V)

2181720, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
The lecture is organized in three parts. In the first part, the mathematical foundations of tensor algebra and tensor analysis are introduced, usually in cartesian representation. In the second part of the lecture, the kinematics, i.e. the geometry of deformation is presented. Besides finite deformation, geometric linearization is discussed. The thrid part of the lecture deals with the physical balance laws of thermomechanics. It is shown, how a special classical theory of continuum mechanics can be derived by adding a corresponding constitutive model. For the illustration of the theory, elementary examples are discussed repeatedly.

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

Literature
lecture notes

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

Responsible: Dr.-Ing. Christian Wilhelm
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102618 - Major Field: Production Technology
M-MACH-102628 - Major Field: Lightweight Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2174575	Foundry Technology	2 SWS	Lecture (V)	Wilhelm
Exams					
SS 2019	76-T-MACH-105157	Foundry Technology		Prüfung (PR)	Wilhelm

Competence Certificate
oral exam; about 25 minutes

Prerequisites
Materials Science I & II must be passed.

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

V **Foundry Technology** **Lecture (V)**
2174575, SS 2019, 2 SWS, Language: German, Open in study portal

Notes

Moulding and casting processes

Solidifying of melts

Castability

Fe-Alloys

Non-Fe-Alloys

Moulding and additive materials

Core production

Sand reclamation

Design in casting technology

Casting simulation

Foundry Processes

learning objectives:

The students know the specific moulding and casting techniques and are able to describe them in detail. The students know the application of moulding and casting techniques concerning castings and metals, their advantages and disadvantages in comparison, their application limits and are able to describe these in detail.

The students know the applied metals and are able to describe advantages and disadvantages as well as the specific range of use.

The students are able, to describe detailled mould and core materials, technologies, their application focus and mould-affected casting defects.

The students know the basics of casting process of any casting parts concerning the above mentioned criteria and are able to describe detailled.

requirements:

Required: Material Science and Engineering I and II

workload:

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

Learning Content

Moulding and casting processes

Solidifying of melts

Castability

Fe-Alloys

Non-Fe-Alloys

Moulding and additive materials

Core production

Sand reclamation

Design in casting technology

Casting simulation

Foundry Processes

Workload

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

Literature

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

T 11.136 Course: Fuels and Lubricants for Combustion Engines [T-MACH-105184]

Responsible: Dr.-Ing. Bernhard Ulrich Kehrwald
Dr.-Ing. Heiko Kubach

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2133108	Fuels and Lubricants for Combustion Engines	2 SWS	Lecture (V)	Kehrwald
Exams					
SS 2019	76-T-MACH-105184	Fuels and Lubricants for Combustion Engines		Prüfung (PR)	Kehrwald
WS 19/20	76-T-MACH-105184	Fuels and Lubricants for Combustion Engines		Prüfung (PR)	Kehrwald

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

Prerequisites
none

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

V Fuels and Lubricants for Combustion Engines
Lecture (V)
2133108, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Introduction and basics

Fuels for Gasoline and Diesel engines

Hydrogen

Lubricants for Gasoline and Diesel engines

Coolants for combustion engines

Learning Content
Introduction and basics

Fuels for Gasoline and Diesel engines

Hydrogen

Lubricants for Gasoline and Diesel engines

Coolants for combustion engines

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

Literature
Lecturer notes

T 11.137 Course: Fundamentals for Design of Motor-Vehicle Bodies I [T-MACH-102116]

Responsible: Horst Dietmar Bardehle
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Oral examination	2	Each winter term	1

Events					
WS 19/20	2113814	Fundamentals for Design of Motor-Vehicles Bodies I	1 SWS	Lecture (V)	Bardehle
Exams					
SS 2019	76-T-MACH-102116	Fundamentals for Design of Motor-Vehicle Bodies I		Prüfung (PR)	Bardehle, Unrau

Competence Certificate
Oral group examination

Duration: 30 minutes

Auxiliary means: none

Prerequisites
none

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

V Fundamentals for Design of Motor-Vehicles Bodies I
2113814, WS 19/20, 1 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Anticipated dates: 23 October 2019, 30 October 2019, 6 November 2019, 20 November 2019, 27 November 2019 (alternate date), and 4 December 2019 (alternate date).
Further information will be published on the homepage of the institute

Learning Content
1. History and design

2. Aerodynamics

3. Design methods (CAD/CAM, FEM)

4. Manufacturing methods of body parts

5. Fastening technologie

6. Body in white / body production, body surface

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature

1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg

T 11.138 Course: Fundamentals for Design of Motor-Vehicle Bodies II [T-MACH-102119]

Responsible: Horst Dietmar Bardehle
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Oral examination	2	Each summer term	1

Events					
SS 2019	2114840	Fundamentals for Design of Motor-Vehicles Bodies II	1 SWS	Lecture (V)	Bardehle
Exams					
SS 2019	76-T-MACH-102119	Fundamentals for Design of Motor-Vehicle Bodies II		Prüfung (PR)	Bardehle, Gauterin

Competence Certificate
Oral group examination

Duration: 30 minutes

Auxiliary means: none

Prerequisites
none

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

V Fundamentals for Design of Motor-Vehicles Bodies II

2114840, SS 2019, 1 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Scheduled dates:
see homepage of the institute.
Further information and possible changes of date: see homepage of the institute.

Learning Content
1. Body properties/testing procedures

2. External body-parts

3. Interior trim

4. Compartment air conditioning

5. Electric and electronic features

6. Crash tests

7. Project management aspects, future prospects

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature

1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg

T 11.139 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	3

Events					
WS 19/20	2193002	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria (with exercises)	2 SWS	Lecture (V)	Seifert
Exams					
SS 2019	76-T-MACH-107670	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria		Prüfung (PR)	Seifert

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.

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.

Recommendation
Bacic course in materials science and engineering

Basic course in mathematics

physics or physical chemistry

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

V Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria (with exercises) — Lecture (V)
2193002, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

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.

Learning 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)

Workload

regular attendance: 22 hours

self-study: 98 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 11.140 Course: Fundamentals in the Development of Commercial Vehicles I [T-MACH-105160]

Responsible: Prof. Dr. Jörg Zürn
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102630 - Major Field: Mobile Machines

Type	Credits	Recurrence	Version
Oral examination	2	Each winter term	1

Events					
WS 19/20	2113812	Fundamentals in the Development of Commercial Vehicles I	1 SWS	Lecture (V)	Zürn
Exams					
SS 2019	76-T-MACH-105160	Fundamentals in the Development of Commercial Vehicles I		Prüfung (PR)	Zürn

Competence Certificate
Oral group examination

Duration: 30 minutes

Auxiliary means: none

Prerequisites
none

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

V Fundamentals in the Development of Commercial Vehicles I
Lecture (V)
2113812, WS 19/20, 1 SWS, Language: German, Open in study portal

Notes
Anticipated dates: 12 November 2019, 19 November 2019, 26 November 2019, and 10 December 2019.
Further information will be published on the homepage of the institute.

Learning Content
1. Introduction, definitions, history

2. Development tools

3. Complete vehicle

4. Cab, bodyshell work

5. Cab, interior fitting

6. Alternative drive systems

7. Drive train

8. Drive system diesel engine

9. Intercooled diesel engines

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature

1. Marwitz, H., Zittel, S.: ACTROS -- die neue schwere Lastwagenbaureihe von Mercedes-Benz, ATZ 98, 1996, Nr. 9

2. Alber, P., McKellip, S.: ACTROS -- Optimierte passive Sicherheit, ATZ 98, 1996

3. Morschheuser, K.: Airbag im Rahmenfahrzeug, ATZ 97, 1995, S. 450 ff.

T 11.141 Course: Fundamentals in the Development of Commercial Vehicles II [T-MACH-105161]

Responsible: Prof. Dr. Jörg Zürn
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102630 - Major Field: Mobile Machines

Type	Credits	Recurrence	Version
Oral examination	2	Each summer term	1

Events					
SS 2019	2114844	Fundamentals in the Development of Commercial Vehicles II	1 SWS	Lecture (V)	Zürn
Exams					
SS 2019	76-T-MACH-105161	Fundamentals in the Development of Commercial Vehicles II		Prüfung (PR)	Zürn

Competence Certificate
Oral group examination

Duration: 30 minutes

Auxiliary means: none

Prerequisites
none

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

V Fundamentals in the Development of Commercial Vehicles II
2114844, SS 2019, 1 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. Gear boxes of commercial vehicles
2. Intermediate elements of the drive train
3. Axle systems
4. Front axles and driving dynamics
5. Chassis and axle suspension
6. Braking System
7. Systems
8. Excursion

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature

1. Schittler, M., Heinrich, R., Kerschbaum, W.: Mercedes-Benz Baureihe 500 -- neue V-Motorengeneration für schwere Nutzfahrzeuge, MTZ 57 Nr. 9, S. 460 ff., 1996

2. Robert Bosch GmbH (Hrsg.): Bremsanlagen für Kraftfahrzeuge, VDI-Verlag, Düsseldorf, 1. Auflage, 1994

3. Rubi, V., Strifler, P. (Hrsg. Institut für Kraftfahrwesen RWTH Aachen): Industrielle Nutzfahrzeugentwicklung, Schriftenreihe Automobiltechnik, 1993

T 11.142 Course: Fundamentals of Automobile Development I [T-MACH-105162]

Responsible: Dipl.-Ing. Rolf Frech
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Written examination	2	Each winter term	1

Events					
WS 19/20	2113810	Fundamentals of Automobile Development I	1 SWS	Lecture (V)	Frech
WS 19/20	2113851	Principles of Whole Vehicle Engineering I	1 SWS	Lecture (V)	Frech
Exams					
SS 2019	76-T-MACH-105162	Fundamentals of Automobile Development I		Prüfung (PR)	Frech, Unrau

Competence Certificate
Written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

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

V Fundamentals of Automobile Development I
2113810, WS 19/20, 1 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Block lecture in room 219 in building 70.04 (Campus East).
Date: 21 October 2019, 28 October 2019 and 4 November 2019 from 8:00 to 11:00 a.m.
Further information will be published on the homepage of the institute.

Learning Content
1. Process of automobile development
2. Conceptual dimensioning and design of an automobile
3. Laws and regulations – National and international boundary conditions
4. Aero dynamical dimensioning and design of an automobile I
5. Aero dynamical dimensioning and design of an automobile II
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature
The scriptum will be provided during the first lessons

V

Principles of Whole Vehicle Engineering I

2113851, WS 19/20, 1 SWS, Language: English, Open in study portal

Lecture (V)

Notes
Block lecture in room 219 in building 70.04 (Campus East), in English.
Date: 21 October 2019, 28 October 2019 and 4 November 2019 from 11:00 a.m. to 2:00 p.m.
Further information will be published on the homepage of the institute.

Learning Content
1. Process of automobile development
2. Conceptual dimensioning and design of an automobile
3. Laws and regulations – National and international boundary conditions
4. Aero dynamical dimensioning and design of an automobile I
5. Aero dynamical dimensioning and design of an automobile II
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature
The scriptum will be provided during the first lessons

T 11.143 Course: Fundamentals of Automobile Development II [T-MACH-105163]

Responsible: Dipl.-Ing. Rolf Frech
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Written examination	2	Each summer term	2

Events					
SS 2019	2114842	Fundamentals of Automobile Development II	1 SWS	Lecture (V)	Frech
SS 2019	2114860	Principles of Whole Vehicle Engineering II	1 SWS		Frech
Exams					
SS 2019	76-T-MACH-105163	Fundamentals of Automobile Development II		Prüfung (PR)	Frech, Unrau

Competence Certificate
Written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

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

V Fundamentals of Automobile Development II
2114842, SS 2019, 1 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. Application-oriented material and production technology I
2. Application-oriented material and production technology II
3. Overall vehicle acoustics in the automobile development
4. Drive train acoustics in the automobile development
5. Testing of the complete vehicle
6. Properties of the complete automobile

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature
The scriptum will be provided during the first lessons.

V Principles of Whole Vehicle Engineering II
2114860, SS 2019, 1 SWS, Language: English, Open in study portal

Notes
In English language.

Learning Content
1. Application-oriented material and production technology I
2. Application-oriented material and production technology II
3. Overall vehicle acoustics in the automobile development
4. Drive train acoustics in the automobile development
5. Testing of the complete vehicle
6. Properties of the complete automobile

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature
The scriptum will be provided during the first lessons.

T 11.144 Course: Fundamentals of Catalytic Exhaust Gas Aftertreatment [T-MACH-105044]

Responsible: Prof. Dr. Olaf Deutschmann
Prof. Dr. Jan-Dierk Grunwaldt
Dr.-Ing. Heiko Kubach
Prof. Dr.-Ing. Egbert Lox

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2134138	Fundamentals of catalytic exhaust gas aftertreatment	2 SWS	Lecture (V)	Lox, Grunwaldt, Deutschmann
Exams					
SS 2019	76-T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment		Prüfung (PR)	Lox
WS 19/20	76-T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment		Prüfung (PR)	Lox

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

Prerequisites
none

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

V Fundamentals of catalytic exhaust gas aftertreatment
Lecture (V)

2134138, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
1. kind and source of emissions
2. emission legislation
3. principal of catalytic exhaust gas aftertreatment (EGA)
4. EGA at stoichiometric gasoline engines
5. EGA at gasoline engines with lean mixtures
6. EGA at diesel engines
7. economical basic conditions for catalytic EGA

Workload
regular attendance: 36 hours
self-study: 84 hours

Literature
Lecture notes available in the lectures

1. ''Environmental Catalysis'' Edited by G.Ertl, H. Knötzinger, J. Weitkamp Wiley-VCH Verlag GmbH, Weinheim, 1999 ISBN 3-527-29827-4
2. ''Cleaner Cars- the history and technology of emission control since the 1960s'' J. R. Mondt Society of Automotive Engineers, Inc., USA, 2000 Publication R-226, ISBN 0-7680-0222-2
3. ''Catalytic Air Pollution Control - commercial technology'' R. M. Heck, R. J. Farrauto John Wiley & Sons, Inc., USA, 1995 ISBN 0-471-28614-1
4. ''Automobiles and Pollution'' P. Degobert Editions Technic, Paris, 1995 ISBN 2-7108-0676-2
5. ''Reduced Emissions and Fuel Consumption in Automobile Engines'' F. Schaeder, R. van Basshuysen, Springer Verlag Wien New York, 1995 ISBN 3-211-82718-8
6. ''Autoabgaskatalysatoren : Grudlagen - Herstellung - Entwicklung - Recycling - Ökologie'' Ch. Hagelüken und 11 Mitautoren, Expert Verlag, Renningen, 2001 ISBN 3-8169-1932-4

T 11.145 Course: Fundamentals of Combustion Engine Technology [T-MACH-105652]

Responsible: Dr.-Ing. Sören Bernhardt
Dr.-Ing. Heiko Kubach
Jürgen Pfeil
Dr.-Ing. Olaf Toedter
Dr.-Ing. Uwe Wagner

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction

Type	Credits	Recurrence	Version
Oral examination	5	Each winter term	1

Events					
WS 19/20	2133123	Fundamentals of Combustion Engine Technology	2 SWS	Lecture (V)	Kubach, Wagner, Toedter, Pfeil, Bernhardt, Velji
Exams					
SS 2019	76-T-MACH-105652	Fundamentals of Combustion Engine Technology		Prüfung (PR)	Kubach
WS 19/20	76-T-MACH-105652	Fundamentals of Combustion Engine Technology		Prüfung (PR)	Kubach

Competence Certificate
oral exam, 30 min

Prerequisites
none

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

V Fundamentals of Combustion Engine Technology
Lecture (V)
2133123, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Fundamentals of engine processes

Components of combustion engines

Mixture formation systems

Gasexchange systems

Injection systems

Exhaust Gas Aftertreatment Systems

Cooling systems

Ignistion Systems

Learning Content

Fundamentals of engine processes

Components of combustion engines

Mixture formation systems

Gasexchange systems

Injection systems

Exhaust Gas Aftertreatment Systems

Cooling systems

Ignistion Systems

Workload

regular attendance 25 h

self-study 125 h

T 11.146 Course: Fundamentals of Combustion I [T-MACH-105213]

Responsible: Prof. Dr. Ulrich Maas
Dr. Jörg Sommerer

Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102635 - Major Field: Engineering Thermodynamics
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2165515	Fundamentals of Combustion I	2 SWS	Lecture (V)	Maas
WS 19/20	2165517	Fundamentals of Combustion I (Tutorial)	1 SWS	Practice (Ü)	Bykov
WS 19/20	3165016	Fundamentals of Combustion I	2 SWS	Lecture (V)	Maas
WS 19/20	3165017	Fundamentals of Combustion I (Tutorial)	1 SWS	Practice (Ü)	Bykov
Exams					
SS 2019	76-T-MACH-105213	Fundamentals of Combustion I		Prüfung (PR)	Maas

Competence Certificate
Written exam, 3 h

Prerequisites
none

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

V Fundamentals of Combustion I

2165515, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Blackboard and Powerpoint presentation

Learning Content

- Fundamental concepts ans phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- Pollutant formation

Annotation
Compulsory elective subject: 2+1 SWS and 5 LP.

Workload
Regular attendance: 22.5 h

Self-study: 97.5 h

Literature
Lecture notes,

Combustion - Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, authors: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

V **Fundamentals of Combustion I (Tutorial)** **Practice (Ü)**
2165517, WS 19/20, 1 SWS, **Open in study portal**

Literature

- Lecture Notes
- J. Warnatz; U. Maas; R.W. Dibble: Combustion, Springer, Heidelberg 1996

T 11.147 Course: Fundamentals of Combustion II [T-MACH-105325]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102635 - Major Field: Engineering Thermodynamics
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2166538	Fundamentals of combustion II	2 SWS	Lecture (V)	Maas
SS 2019	2166539	Übung zu Grundlagen der technischen Verbrennung II	1 SWS	Practice (Ü)	Maas

Competence Certificate
oral exam, 20 min

Prerequisites
none

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

V Fundamentals of combustion II
2166538, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Blackboard and Powerpoint presentation

Learning 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
- NOx formation
- Formation of hydrocarbons and soot
- Thermodynamics of combustion processes
- Transport phenomena

Workload
Regular attendance: 35 hours

Self-study: 95 hours

Literature
Lecture notes;

Combustion - Physical and Chemical Fundamentals, Modeling and Simulation,Experiments, Pollutant Formation; Authors: U. Maas, J. Warnatz, R.W. Dibble, Springer; Heidelberg, Karlsruhe, Berkley 2006

V

Übung zu Grundlagen der technischen Verbrennung II

2166539, SS 2019, 1 SWS, Language: German, Open in study portal

Practice (Ü)

Learning Content
Calculation and Simulation of combustion processes

Workload
regular attendance: 21 hours

Literature
Lecture notes
Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

T 11.148 Course: Fundamentals of Energy Technology [T-MACH-105220]

Responsible: Dr. Aurelian Florin Badea
Prof. Dr.-Ing. Xu Cheng

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102623 - Major Field: Fundamentals of Energy Technology

Type	Credits	Recurrence	Version
Written examination	8	Each summer term	1

Events					
SS 2019	2130927	Fundamentals of Energy Technology	3 SWS	Lecture (V)	Cheng, Badea
SS 2019	3190923	Fundamentals of Energy Technology	3 SWS	Lecture (V)	Badea
Exams					
SS 2019	76-MACH-105220 Fundamentals of Energy Technology	Fundamentals of Energy Technology		Prüfung (PR)	Badea
SS 2019	76-T-MACH-105220	Fundamentals of Energy Technology		Prüfung (PR)	Cheng, Badea
WS 19/20	76-MACH-105220 Fundamentals of Energy Technology	Fundamentals of Energy Technology		Prüfung (PR)	Badea
WS 19/20	76-T-MACH-105220	Fundamentals of Energy Technology		Prüfung (PR)	Badea, Cheng

Competence Certificate
Written examination, 90 min

Prerequisites
none

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

V Fundamentals of Energy Technology
2130927, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
The following relevant fields of the energy industry are covered:
- Energy demand and energy situation
- Energy types and energy mix
- Basics. Thermodynamics relevant to the energy sector
- Conventional fossil-fired power plants
- Combined Cycle Power Plants
- Cogeneration
- Nuclear energy
- Regenerative energies: hydropower, wind energy, solar energy, other energy systems
- Energy demand structures. Basics of economic efficiency and calculus. Optimization
- Energy storage
- Transport of energy
- Power generation and environment. Future of the energy industry

Workload
lectures: 45 h

preparation to exam: 195 h

V	**Fundamentals of Energy Technology** 3190923, SS 2019, 3 SWS, Language: English, Open in study portal	**Lecture (V)**

Learning Content
The following relevant fields of the energy industry are covered:
- Energy forms
- Thermodynamics relevant to energy industry
- Energy sources: fossil fuels, nuclear energy, renewable sources
- Energy industry in Germany, Europe and worldwide
- Power generation and environment
- Evaluation of energy conversion processes
- Thermal/electrical power plants and processes
- Transport of energy / energy carriers
- Energy storage
- Systems utilizing renewable energy sources
- Basics of economic efficiency and calculus / Optimisation
- Future of the energy industry

Workload
lectures: 45 h

preparation to exam: 195 h

T 11.149 Course: Fundamentals of reactor safety for the operation and dismantling of nuclear power plants [T-MACH-105530]

Responsible: Dr. Victor Hugo Sanchez-Espinoza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102608 - Major Field: Nuclear Energy

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2190465	Fundamentals of reactor safety for the operation and dismantling of nuclear power plants	2 SWS		Sanchez-Espinoza

Competence Certificate
oral exam about 30 minutes

Prerequisites
none

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

V Fundamentals of reactor safety for the operation and dismantling of nuclear power plants
2190465, WS 19/20, 2 SWS, Language: English, Open in study portal

Notes
This lecture describes the fundamentals of reactor safety for both the operation and the decommissioning of nuclear power plants. The first part will be focused on reactor safety issues important for the operation of a NPP:

- Safety fundamentals as defense in depth, multi-barrier concepts
- Operational modes of nuclear power plants
- Main components for heat removal, safety systems of selected NPP designs
- Thermal characterization of the core and plant under normal operation conditions
- Accident analysis in nuclear power plants- initiation, methods of evaluations and safety implications

The second part of this lecture will be devoted to explain the neutron physical, radiation protection and safety aspects to be considered for the safe and economical decommissioning of nuclear power plants:

- Life cycle of a nuclear power plant and main strategies and challenges in the NPP decommissioning
- Physical processes responsible for the activation of reactor components during the operation of a nuclear power plant
- Radioactive waste generation in the core, classification and radiological relevance
- Waste classification, minimization methods and intermediate and final disposal
- Risk analysis and prevention, radiation protection issues and the regulatory framework for decommissioning
- Computational methods for the estimation of nuclei inventories, activation and dose rates of reactor components

Knowledge in energy technology, nuclear power plants, reactor physics, radiation protection is welcomed

Time of attendance: 30 hours

Self-study: 90 hours

oral examination; duration: about 30 minutes

Learning Content

This lecture describes the fundamentals of reactor safety for both the operation and the decommissioning of nuclear power plants. The first part will be focused on reactor safety issues important for the operation of a NPP:

- Safety fundamentals as defense in depth, multi-barrier concepts
- Operational modes of nuclear power plants
- Main components for heat removal, safety systems of selected NPP designs
- Thermal characterization of the core and plant under normal operation conditions
- Accident analysis in nuclear power plants- initiation, methods of evaluations and safety implications

The second part of this lecture will be devoted to explain the neutron physical, radiation protection and safety aspects to be considered for the safe and economical decommissioning of nuclear power plants:

- Life cycle of a nuclear power plant and main strategies and challenges in the NPP decommissioning
- Physical processes responsible for the activation of reactor components during the operation of a nuclear power plant
- Radioactive waste generation in the core, classification and radiological relevance
- Waste classification, minimization methods and intermediate and final disposal
- Risk analysis and prevention, radiation protection issues and the regulatory framework for decommissioning
- Computational methods for the estimation of nuclei inventories, activation and dose rates of reactor components

Workload

Time of attendance: 30 hours

Self-study: 90 hours

Literature

Bibliography related to the Block Course *"Fundamentals of Reactor Safety for the Operation and Dismantling of NPPs"*

1. **M. Laraia, "Nuclear decommissioning: planning, execution and international experience", Woodhead Publishing (2012).**
2. **"Radiological Characterization of Shut Down Nuclear Reactors for Decommissioning Purposes", IAEA Technical Report Series No. 389**
3. **"Classification of radioactive waste", IAEA Safety Standards No. GSG-1.**
4. **"Innovative and Adaptive Technologies in Decommissioning of Nuclear Facilities", IAEA-TECDOC-1602.**
5. **"Planning, Management and Organizational Aspects of the Decommissioning of Nuclear Facilities", IAEA-TECDOC-1702.**
6. **"Managing Low Radioactivity Material from the Decommissioning of Nuclear Facilities", IAEA Technical Report Series No. 462.**
7. **"Safe and effective nuclear power plant life cycle management towards decommissioning", IAEA-TECDOC-1305.**
8. **"Radiological Characterisation for Decommissioning of Nuclear Installations", NEA/RWM/WPDD(2013)2.**
9. **"Proceedings of the ICOND16/International Conference on Nuclear Decommissioning", October 2014 (Aachen, Germany).**
10. **M. Cumo, "Experiences and Techniques in the Decommissioning of Old Nuclear Power Plants, Workshop on Nuclear Reaction Data and Nuclear Reactors: Physics, Design and Safety", 25 February – 28 March 2002 (Trieste, Italy).**
11. **"Safety considerations in the Transition from Operation to Decommissioning of Nuclear Facilities", IAEA Technical Report Series 36.**
12. **"State of the Art Technology for Decontamination and Dismantling of Nuclear Facilities", IAEA Technical Report Series395.**
13. **"A review of the situation of decommissioning of nuclear installations in Europe", European Commission Report EUR 17622**
14. **"Radiation Protection Ordinance", (*http://www.bfs.de*).**

T 11.150 Course: Fusion Technology A [T-MACH-105411]

Responsible: Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2169483	Fusion Technology A	2 SWS	Lecture / Practice (VÜ)	Stieglitz
WS 19/20	2169484	Exercise Fusion Technology A	2 SWS	Practice (Ü)	Stieglitz
Exams					
SS 2019	76-T-MACH-105411	Fusion Technology A		Prüfung (PR)	Stieglitz
WS 19/20	76-T-MACH-105411	Fusion Technology A		Prüfung (PR)	Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Recommendation
appreciated is knowldege in heat ans mass transfer as well as in electrical engineering,
basic knowledge in fluid mechanics, material sciences and physics

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

V Fusion Technology A

Lecture / Practice (VÜ)

2169483, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

To transfer the basic physical concepts of particle physics, fusion and nuclear fission; this includes fundamental questions such as how: What is a plasma? How can it be ignited? What is the difference between magnetic and inertial fusion? Based on this, aspects of the stability of plasmas, their control and particle transport are discussed. After characterizing the plasma, the "fire" of fusion, the confinement in magnetic fields is sketched, which are built up with the help of magnetic technology. Here, knowledge of superconductivity, production and design of magnets is imparted. A reactor operation with a plasma as energy source requires a continuous operation of a tritium and fuel cycle, which is generated by the fusion reactor itself. Since fusion plasmas require small material densities, vacuum technology plays a central role. Finally, the heat generated in the fusion power plant must be converted into a power plant process and the reaction products removed. The functional basics and the structure of these fusion-typical in-vessel components are presented and the current challenges and the state of the art are demonstrated.

The course describes the essential functional principles of a fusion reactor, beginning with plasma, magnet technology, the tritium and fuel cycle, vacuum technology and the associated material sciences. The physical basics will be taught and the engineering laws of scaling will be demonstrated. Special importance is attached to the understanding of the interfaces between the different subject areas, which essentially determine the engineering technical interpretations. Methods for identifying and evaluating the central parameters will be demonstrated. Based on the acquired perception skills, methods for the design of solution strategies will be taught and technical solutions will be identified, their weak points discussed and evaluated.

Recommendations/Pre-knowledge:

Basic knowledge of fluid mechanics, materials engineering and physics. Knowledge of heat and mass transfer and electrical engineering is helpful.

Presence time: 21 h
Self-study: 90 h

Oral examination:
Duration: approx. 30 minutes, aids: none

Workload

regular attendance: 21 h
self-study:90 h

Literature

Within each subblock an adequate selection of literature is given. Additionally the students get the lecuture materials in printed and electronic version.

T 11.151 Course: Fusion Technology B [T-MACH-105433]

Responsible: Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190492	Fusion Technology B	2 SWS	Lecture (V)	Stieglitz
SS 2019	2190493	Übungen zu Fusionstechnologie B	2 SWS	Practice (Ü)	Stieglitz
Exams					
SS 2019	76-T-MACH-105433	Fusion Technology B		Prüfung (PR)	Stieglitz
WS 19/20	76-T-MACH-105433	Fusion Technology B		Prüfung (PR)	Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Recommendation
attendance of fusion technology A lecture

reliable capability to use fundamental knowledge communicated in the bachelor study in physics, material sciences , electrical engineering and engineering design

Annotation
none

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

V Fusion Technology B
2190492, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

Fusion Technology B is a continuation of Fusion Technology A lecture and includes the following topics:

Fusion neutronics, materials science of thermally and neutronically highly loaded components, reactor scaling and safety as well as plasma heating and current drive. The section fusion neutronics develops the basics of fusion neutronics and its calculation methods, the nuclear physical design of a fusion reactor and the corresponding components (blankets, shielding, activation, tritium breeding ratio and dose rate). Since both neutron fluxes and area power density in a fusion power plant are significantly higher than those of other power plants, they require special materials. After an extension of existing material knowledge by fundamentals and methods for the calculation of radiation damage in materials, strategies for the material selection of functional and structural materials are shown and deepened by examples. The arrangement of components close to the plasma in a fusion power plant means changed requirements for system integration and energy conversion; these questions are the subject of the block reactor scaling and safety. In addition to the explanation of the safety objectives, the methods for achieving the objectives and the computational tools required to achieve them are dealt with in particular. To ignite the plasma, extreme temperatures of several million degrees are required. Special plasma heating methods are used for this purpose, such as electron cyclotron resonance heating (ECRH), ion cyclotron resonance heating (ICRH), current drive at the lower hybrid frequency and neutral particle injection. Their basic mode of action, design criteria, transmission options and performance are presented and discussed. In addition, the heating processes can also be used for plasma stabilization. Some considerations and limitations are presented.

The lecture, which runs over 2 semesters, is aimed at students of engineering sciences and physics after the bachelor. The aim is an introduction to the current research and development on fusion and its long-term goal of a promising energy source. After a short insight into fusion physics, the lecture focuses on key technologies for a future fusion reactor. The lecture will be accompanied by exercises at Campus Nord (block event, 2-3 afternoons per topic).

Recommendations/Prerequisites:

Knowledge of physics, heat and mass transfer, and design theory taught in the bachelor's degree. Attendance of the lecture Fusion technology A

Presence time: 21 h
Self-study: 49 h

Oral proof of participation in the exercises
Duration: approx. 25 minutes, aids: none

Learning Content

Die Fusionstechnologie B beinhaltet

Fusion neutronics, plasma facing components and plasma heating-and current drive methods. The section fusion neutronics scopes the fundamentals and calculation methods, which allows for a physical design of a nuclear fusion reactor and the corresponding components (such as blankets, divertors, shielding, activation and dose rate). Fusion reactors produce fuel their "self". The necessary blankets are complex structures whose foundations and concept options, design criteria and methods are discussed. Also the divertor is a plasma facing component. Its tasks, constraints, and design concepts are explained. The arrangement of the plasma facing components in a fusion power plant means changing demands on the system integration and energy conversion. To ignite the plasma extreme temperatures of several million degrees are required. For this purpose, special plasma heating techniques are used such as electron cyclotron resonance heating (ECRH), ion-cyclotron resonance heating (ICRH), the current drive at the lower hybrid frequency, and the neutral particle injection. Their basic mode of action, the design criteria, the transmission options and performance are presented and discussed. Additionally the heating method used also for plasma stabilization. Here are some considerations and limitations are presented.

Workload

regular attendance: 21 h
self-study: 49 h

Literature

Lecture notes

McCracken, Peter Scott, Fusion, The Energy of Universe, Elsevier Academic Press, ISBN: 0-12-481851-X

T 11.152 Course: Gasdynamics [T-MACH-105533]

Responsible: Dr.-Ing. Franco Magagnato
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102634 - Major Field: Fluid Mechanic
M-MACH-102635 - Major Field: Engineering Thermodynamics
M-MACH-102636 - Major Field: Thermal Turbomachines
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2154200	Gasdynamics	2 SWS	Lecture (V)	Magagnato
Exams					
SS 2019	76-T-MACH-105533	Gasdynamics		Prüfung (PR)	Magagnato
WS 19/20	76-T-MACH-105533	Gasdynamics		Prüfung (PR)	Magagnato

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

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

V Gasdynamics
Lecture (V)

2154200, WS 19/20, 2 SWS, Language: English, Open in study portal

Description
Powerpoint presentation

Notes

The student can describe the governing equations of Gas Dynamics and the associated basics in Thermodynamics. He will know different flow phenomena of applied Gas Dynamics. He can calculate compressible flows analytically. He is familiar with the Rankine-Hugoniot curve. They can derive the continuity-, the momentum- and the energy equations in differential form. With the help of the stationary flow filament theory they can calculate the normal shock wave and the associated increase of the entropy along past the shock wave. They are able to calculate the stagnation values of the Gas Dynamical variables and to determine their critical values. The students can apply the flow filament theory for variable cross-sectional areas and can distinguish between the different flow fields inside the Laval nozzle that forms with different boundary conditions. He can calculate the values behind an oblique shock wave and can distinguish between detached and attached shock waves. The student can calculate the Prandtl-Meyer expansion wave.

This lecture covers the following topics:

- Introduction to gas dynamics
- Numerical and experimental examples
- Governing equations of gas dynamics
- The transport equations in differential and integral form
- Stationary flow filament theory with and without normal shock waves
- Discussion of the energy equation: Stagnation and critical values
- Flow filament theory at variable cross-sectional area. Flow inside a Laval nozzle
- Oblique shock waves, detached shock waves
- Prandtl-Meyer expansion wave
- Viscous flows (Fanno flow)

Learning Content

This lecture covers the following topics:

- Introduction, basics of Thermodynamics
- Governing equations of gas dynamics
- Application of the conservation equations
- The transport equations in differential form
- Stationary flow filament theory with and without shock waves
- Discussion of the energy equation: Stagnation and critical values

Flow filament theory for variable cross-sectional areas. Flow inside a Laval nozzle

Workload

regular attendance: 21 hours

self-study: 84 hours

Literature

John, J., and Keith T. Gas Dynamics. 3rd ed. Harlow: Prentice Hall, 2006

Rathakrishnan, E. *Gas Dynamics*. Prentice Hall of India Pvt. Ltd, 2006

T 11.153 Course: Gear Cutting Technology [T-MACH-102148]

Responsible: Dr. Markus Klaiber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2149655	Gear Technology	2 SWS	Lecture (V)	Klaiber
Exams					
SS 2019	76-T-MACH-102148	Gear Cutting Technology		Prüfung (PR)	Schulze

Competence Certificate
Oral Exam (20 min)

Prerequisites
none

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

V Gear Technology
2149655, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

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

Notes
Based on the gearing theory, manufacturing processes and machine technologies for producing gearings, the needs of modern gear manufacturing will be discussed in the lecture. For this purpose, various processes for various gear types are taught which represent the state of the art in practice today. A classification in soft and hard machining and furthermore in cutting and non-cutting technologies will be made. For comprehensive understanding the processes, machine technologies, tools and applications of the manufacturing of gearings will be introduced and the current developments presented. For assessment and classification of the applications and the performance of the technologies, the methods of mass production and manufacturing defects will be discussed. Sample parts, reports from current developments in the field of research and an excursion to a gear manufacturing company round out the lecture.

Learning Outcomes:

The students ...

- can describe the basic terms of gearings and are able to explain the imparted basics of the gearwheel and gearing theory.
- are able to specify the different manufacturing processes and machine technologies for producing gearings. Furthermore they are able to explain the functional principles and the dis-/advantages of these manufacturing processes.
- can apply the basics of the gearing theory and manufacturing processes on new problems.
- are able to read and interpret measuring records for gearings. are able to make an appropriate selection of a process based on a given application
- can describe the entire process chain for the production of toothed components and their respective influence on the resulting workpiece properties.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content
Based on the gearing theory, manufacturing processes and machine technologies for producing gearings, the needs of modern gear manufacturing will be discussed in the lecture. For this purpose, various processes for various gear types are taught which represent the state of the art in practice today. A classification in soft and hard machining and furthermore in cutting and non-cutting technologies will be made. For comprehensive understanding the processes, machine technologies, tools and applications of the manufacturing of gearings will be introduced and the current developments presented. For assessment and classification of the applications and the performance of the technologies, the methods of mass production and manufacturing defects will be discussed. Sample parts, reports from current developments in the field of research and an excursion to a gear manufacturing company round out the lecture.

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

T 11.154 Course: Global Production and Logistics [T-MACH-110337]

Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102618 - Major Field: Production Technology

Type	Credits	Version
Oral examination	8	1

Events					
SS 2019	2149600	Global Production and Logistics - Part 2: Global Logistics	2 SWS	Lecture (V)	Furmans
WS 19/20	2149610	Global Production and Logistics - Part 1: Global Production	2 SWS	Lecture (V)	Lanza

Competence Certificate
oral exam (40 min)

Prerequisites
The following courses must not be started :

- Globale Production and Logistics - Part 1: Global Production [T-MACH-105158 oder T-MACH-108848]
- Globale Production and Logistics - Part 2: Global Logistics [T-MACH-105159]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108848 - Global Production and Logistics - Part 1: Global Production must not have been started.
2. The course T-MACH-105158 - Global Production and Logistics - Part 1: Global Production must not have been started.
3. The course T-MACH-105159 - Global Production and Logistics - Part 2: Global Logistics must not have been started.

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

V Global Production and Logistics - Part 2: Global Logistics

Lecture (V)

2149600, SS 2019, 2 SWS, Language: German, Open in study portal

Description
Media:

presentations, black board

Notes
Characteristics of global trade

- Incoterms
- Customs clearance, documents and export control

Global transport and shipping

- Maritime transport, esp. container handling
- Air transport

Modeling of supply chains

- SCOR model
- Value stream analysis

Location planning in cross-border-networks

- Application of the Warehouse Location Problem
- Transport Planning

Inventory Management in global supply chains

- Stock keeping policies

Inventory management considering lead time and shipping costs

After taking this course students are able to:

- assign basic problems of planning and operation of global supply chains and plan them with apropriate methods,
- describe requirements and characteristics of global trade and transport, and
- evaluate characteristics of the design from logistic chains regarding their suitability.

The assessment consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

The main exam is offered every summer semester. A second date for the exam is offered in winter semester only for students that did not pass the main exam.

Recommendations:

We recommend the course "Logistics - organisation, design and control of logistic systems " (2118078) beforehand.

regular attendance: 21 hours
self-study: 99 hours

Learning Content
Characteristics of global trade

- Incoterms
- Customs clearance, documents and export control

Global transport and shipping

- Maritime transport, esp. container handling
- Air transport

Modeling of supply chains

- SCOR model
- Value stream analysis

Location planning in cross-border-networks

- Application of the Warehouse Location Problem
- Transport Planning

Inventory Management in global supply chains

- Stock keeping policies

Inventory management considering lead time and shipping costs

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

Literature
Elective literature:

- Arnold/Isermann/Kuhn/Tempelmeier. HandbuchLogistik, Springer Verlag, 2002 (Neuauflage in Arbeit)
- Domschke. Logistik, Rundreisen und Touren,Oldenbourg Verlag, 1982
- Domschke/Drexl. Logistik, Standorte, OldenbourgVerlag, 1996
- Gudehus. Logistik, Springer Verlag, 2007
- Neumann-Morlock. Operations-Research,Hanser-Verlag, 1993
- Tempelmeier. Bestandsmanagement in SupplyChains, Books on Demand 2006
- Schönsleben. IntegralesLogistikmanagement, Springer, 1998

V **Global Production and Logistics - Part 1: Global Production** **Lecture (V)**
2149610, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

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

Notes

The lecture examines the management of global production networks of manufacturing companies. It gives an overview of the influencing factors and challenges of global production. In-depth knowledge of common methods and procedures for planning, designing and managing global production networks is imparted.

Therefore, the lecture first of all discusses the connections and interdependencies between the business strategy and the production strategy and illustrates necessary tasks for the definition of a production strategy. Methods for site selection, for the site-specific adaptation of product design and production technology as well as for the establishment of new production sites and for the adaptation of existing production networks to changing framework conditions are subsequently taught within the context of the design of the network footprint. With regard to the management of global production networks, the lecture addresses challenges associated with coordination, procurement and order management in global networks. The lecture is complemented by a discussion on the use of industry 4.0 applications in global production and current trends in planning, designing and managing global production networks.

The topics include:

- Basic conditions and influencing factors of global production (historical development, targets, chances and threats)
- Framework for planning, designing and managing global production networks
- Production strategies for global production networks
  - From business strategy to production strategy
  - Tasks of the production strategy (product portfolio management, circular economy, planning of production depth, production-related research and development)
- Design of global production networks
  - Basic types of network structures
  - Planning process for the design of the network footprint
  - Adaptation of the network footprint
  - Site selection
  - Location-specific adaptation of production technology and product design
- Management of global production networks
  - Network coordination
  - Procurement process
  - Order management

- Trends in planning, designing and managing global production networks

Learning Outcomes:

The students ...

- can explain the general conditions and influencing factors of global production
- are capable to apply defined procedures for site selection and to evaluate site decisions with the help of different methods
- are able to select the adequate scope of design for siteappropriate production and product construction casespecifically
- can state the central elements in the planning process of establishing a new production site.
- are capable to make use of the methods to design and scale global production networks for company-individual problems

- are able to show up the challenges and potentials of the departments sales, procurement as well as research and development on global basis.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Recommendations:

Combination with Global Production and Logistics – Part 2

Learning Content

The lecture examines the management of global production networks of manufacturing companies. It gives an overview of the influencing factors and challenges of global production. In-depth knowledge of common methods and procedures for planning, designing and managing global production networks is imparted.

Therefore, the lecture first of all discusses the connections and interdependencies between the business strategy and the production strategy and illustrates necessary tasks for the definition of a production strategy. Methods for site selection, for the site-specific adaptation of product design and production technology as well as for the establishment of new production sites and for the adaptation of existing production networks to changing framework conditions are subsequently taught within the context of the design of the network footprint. With regard to the management of global production networks, the lecture addresses challenges associated with coordination, procurement and order management in global networks. The lecture is complemented by a discussion on the use of industry 4.0 applications in global production and current trends in planning, designing and managing global production networks.

The topics include:

- Basic conditions and influencing factors of global production (historical development, targets, chances and threats)
- Framework for planning, designing and managing global production networks
- Production strategies for global production networks
  - From business strategy to production strategy
  - Tasks of the production strategy (product portfolio management, circular economy, planning of production depth, production-related research and development)
- Design of global production networks
  - Basic types of network structures
  - Planning process for the design of the network footprint
  - Adaptation of the network footprint
  - Site selection
  - Location-specific adaptation of production technology and product design
- Management of global production networks
  - Network coordination
  - Procurement process
  - Order management
- Trends in planning, designing and managing global production networks

Annotation

None

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Lecture Notes
recommended secondary literature:
Abele, E. et al: Global Production – A Handbook for Strategy and Implementation, Springer 2008 (english)

T 11.155 Course: Global Production and Logistics - Part 1: Global Production [T-MACH-108848]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102629 - Major Field: Logistics and Material Flow Theory

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2149610	Global Production and Logistics - Part 1: Global Production	2 SWS	Lecture (V)	Lanza
Exams					
SS 2019	76-T-MACH-108848	Global Production and Logistics - Part 1: Global Production		Prüfung (PR)	Lanza

Competence Certificate
Oral Exam (20 min)

Prerequisites
"T-MACH-105158 - Globale Produktion und Logistik - Teil 1: Globale Produktion" must not be commenced.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105158 - Global Production and Logistics - Part 1: Global Production must not have been started.

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

V Global Production and Logistics - Part 1: Global Production — Lecture (V)
2149610, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

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

Notes

The lecture examines the management of global production networks of manufacturing companies. It gives an overview of the influencing factors and challenges of global production. In-depth knowledge of common methods and procedures for planning, designing and managing global production networks is imparted.

Therefore, the lecture first of all discusses the connections and interdependencies between the business strategy and the production strategy and illustrates necessary tasks for the definition of a production strategy. Methods for site selection, for the site-specific adaptation of product design and production technology as well as for the establishment of new production sites and for the adaptation of existing production networks to changing framework conditions are subsequently taught within the context of the design of the network footprint. With regard to the management of global production networks, the lecture addresses challenges associated with coordination, procurement and order management in global networks. The lecture is complemented by a discussion on the use of industry 4.0 applications in global production and current trends in planning, designing and managing global production networks.

The topics include:

- Basic conditions and influencing factors of global production (historical development, targets, chances and threats)
- Framework for planning, designing and managing global production networks
- Production strategies for global production networks
    - From business strategy to production strategy
    - Tasks of the production strategy (product portfolio management, circular economy, planning of production depth, production-related research and development)
- Design of global production networks
    - Basic types of network structures
    - Planning process for the design of the network footprint
    - Adaptation of the network footprint
    - Site selection
    - Location-specific adaptation of production technology and product design
- Management of global production networks
    - Network coordination
    - Procurement process
    - Order management

- Trends in planning, designing and managing global production networks

Learning Outcomes:

The students ...

- can explain the general conditions and influencing factors of global production
- are capable to apply defined procedures for site selection and to evaluate site decisions with the help of different methods
- are able to select the adequate scope of design for siteappropriate production and product construction casespecifically
- can state the central elements in the planning process of establishing a new production site.
- are capable to make use of the methods to design and scale global production networks for company-individual problems

- are able to show up the challenges and potentials of the departments sales, procurement as well as research and development on global basis.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Recommendations:

Combination with Global Production and Logistics – Part 2

Learning Content

The lecture examines the management of global production networks of manufacturing companies. It gives an overview of the influencing factors and challenges of global production. In-depth knowledge of common methods and procedures for planning, designing and managing global production networks is imparted.

Therefore, the lecture first of all discusses the connections and interdependencies between the business strategy and the production strategy and illustrates necessary tasks for the definition of a production strategy. Methods for site selection, for the site-specific adaptation of product design and production technology as well as for the establishment of new production sites and for the adaptation of existing production networks to changing framework conditions are subsequently taught within the context of the design of the network footprint. With regard to the management of global production networks, the lecture addresses challenges associated with coordination, procurement and order management in global networks. The lecture is complemented by a discussion on the use of industry 4.0 applications in global production and current trends in planning, designing and managing global production networks.

The topics include:

- Basic conditions and influencing factors of global production (historical development, targets, chances and threats)
- Framework for planning, designing and managing global production networks
- Production strategies for global production networks
    - From business strategy to production strategy
    - Tasks of the production strategy (product portfolio management, circular economy, planning of production depth, production-related research and development)
- Design of global production networks
    - Basic types of network structures
    - Planning process for the design of the network footprint
    - Adaptation of the network footprint
    - Site selection
    - Location-specific adaptation of production technology and product design
- Management of global production networks
    - Network coordination
    - Procurement process
    - Order management
- Trends in planning, designing and managing global production networks

Annotation

None

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Lecture Notes
recommended secondary literature:
Abele, E. et al: Global Production – A Handbook for Strategy and Implementation, Springer 2008 (english)

T 11.156 Course: Global Production and Logistics - Part 1: Global Production [T-MACH-105158]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2149610	Global Production and Logistics - Part 1: Global Production	2 SWS	Lecture (V)	Lanza
Exams					
SS 2019	76-T-MACH-105158	Global Production and Logistics - Part 1: Global Production		Prüfung (PR)	Lanza

Competence Certificate
Written Exam (60 min)

Prerequisites
"T-MACH-108848 - Globale Produktion und Logistik - Teil 1: Globale Produktion" must not be commenced.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108848 - Global Production and Logistics - Part 1: Global Production must not have been started.

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

V Global Production and Logistics - Part 1: Global Production

Lecture (V)

2149610, WS 19/20, 2 SWS, Language: German, Open in study portal

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

Notes

The lecture examines the management of global production networks of manufacturing companies. It gives an overview of the influencing factors and challenges of global production. In-depth knowledge of common methods and procedures for planning, designing and managing global production networks is imparted.

Therefore, the lecture first of all discusses the connections and interdependencies between the business strategy and the production strategy and illustrates necessary tasks for the definition of a production strategy. Methods for site selection, for the site-specific adaptation of product design and production technology as well as for the establishment of new production sites and for the adaptation of existing production networks to changing framework conditions are subsequently taught within the context of the design of the network footprint. With regard to the management of global production networks, the lecture addresses challenges associated with coordination, procurement and order management in global networks. The lecture is complemented by a discussion on the use of industry 4.0 applications in global production and current trends in planning, designing and managing global production networks.

The topics include:

- Basic conditions and influencing factors of global production (historical development, targets, chances and threats)
- Framework for planning, designing and managing global production networks
- Production strategies for global production networks
    - From business strategy to production strategy
    - Tasks of the production strategy (product portfolio management, circular economy, planning of production depth, production-related research and development)
- Design of global production networks
    - Basic types of network structures
    - Planning process for the design of the network footprint
    - Adaptation of the network footprint
    - Site selection
    - Location-specific adaptation of production technology and product design
- Management of global production networks
    - Network coordination
    - Procurement process
    - Order management

- Trends in planning, designing and managing global production networks

Learning Outcomes:

The students ...

- can explain the general conditions and influencing factors of global production
- are capable to apply defined procedures for site selection and to evaluate site decisions with the help of different methods
- are able to select the adequate scope of design for siteappropriate production and product construction casespecifically
- can state the central elements in the planning process of establishing a new production site.
- are capable to make use of the methods to design and scale global production networks for company-individual problems

- are able to show up the challenges and potentials of the departments sales, procurement as well as research and development on global basis.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Recommendations:

Combination with Global Production and Logistics – Part 2

Learning Content

The lecture examines the management of global production networks of manufacturing companies. It gives an overview of the influencing factors and challenges of global production. In-depth knowledge of common methods and procedures for planning, designing and managing global production networks is imparted.

Therefore, the lecture first of all discusses the connections and interdependencies between the business strategy and the production strategy and illustrates necessary tasks for the definition of a production strategy. Methods for site selection, for the site-specific adaptation of product design and production technology as well as for the establishment of new production sites and for the adaptation of existing production networks to changing framework conditions are subsequently taught within the context of the design of the network footprint. With regard to the management of global production networks, the lecture addresses challenges associated with coordination, procurement and order management in global networks. The lecture is complemented by a discussion on the use of industry 4.0 applications in global production and current trends in planning, designing and managing global production networks.

The topics include:

- Basic conditions and influencing factors of global production (historical development, targets, chances and threats)
- Framework for planning, designing and managing global production networks
- Production strategies for global production networks
    - From business strategy to production strategy
    - Tasks of the production strategy (product portfolio management, circular economy, planning of production depth, production-related research and development)
- Design of global production networks
    - Basic types of network structures
    - Planning process for the design of the network footprint
    - Adaptation of the network footprint
    - Site selection
    - Location-specific adaptation of production technology and product design
- Management of global production networks
    - Network coordination
    - Procurement process
    - Order management
- Trends in planning, designing and managing global production networks

Annotation

None

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Lecture Notes
recommended secondary literature:
Abele, E. et al: Global Production – A Handbook for Strategy and Implementation, Springer 2008 (english)

T 11.157 Course: Global Production and Logistics - Part 2: Global Logistics [T-MACH-105159]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102618 - Major Field: Production Technology
M-MACH-102629 - Major Field: Logistics and Material Flow Theory
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2149600	Global Production and Logistics - Part 2: Global Logistics	2 SWS	Lecture (V)	Furmans
Exams					
SS 2019	76-T-MACH-105159	Global Production and Logistics - Part 2: Global Logistics		Prüfung (PR)	Furmans

Competence Certificate
The assessment consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

Prerequisites
none

Recommendation
We recommend attending the course "Logistics - organization, design and control of logistic systems " (2118078) beforehand.

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

V Global Production and Logistics - Part 2: Global Logistics
2149600, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

presentations, black board

Notes

Characteristics of global trade

- Incoterms
- Customs clearance, documents and export control

Global transport and shipping

- Maritime transport, esp. container handling
- Air transport

Modeling of supply chains

- SCOR model
- Value stream analysis

Location planning in cross-border-networks

- Application of the Warehouse Location Problem
- Transport Planning

Inventory Management in global supply chains

- Stock keeping policies

Inventory management considering lead time and shipping costs

After taking this course students are able to:

- assign basic problems of planning and operation of global supply chains and plan them with apropriate methods,
- describe requirements and characteristics of global trade and transport, and
- evaluate characteristics of the design from logistic chains regarding their suitability.

The assessment consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

The main exam is offered every summer semester. A second date for the exam is offered in winter semester only for students that did not pass the main exam.

Recommendations:

We recommend the course "Logistics - organisation, design and control of logistic systems " (2118078) beforehand.

regular attendance: 21 hours
self-study: 99 hours

Learning Content

Characteristics of global trade

- Incoterms
- Customs clearance, documents and export control

Global transport and shipping

- Maritime transport, esp. container handling
- Air transport

Modeling of supply chains

- SCOR model
- Value stream analysis

Location planning in cross-border-networks

- Application of the Warehouse Location Problem
- Transport Planning

Inventory Management in global supply chains

- Stock keeping policies

Inventory management considering lead time and shipping costs

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Elective literature:

- Arnold/Isermann/Kuhn/Tempelmeier. HandbuchLogistik, Springer Verlag, 2002 (Neuauflage in Arbeit)
- Domschke. Logistik, Rundreisen und Touren,Oldenbourg Verlag, 1982
- Domschke/Drexl. Logistik, Standorte, OldenbourgVerlag, 1996
- Gudehus. Logistik, Springer Verlag, 2007
- Neumann-Morlock. Operations-Research,Hanser-Verlag, 1993
- Tempelmeier. Bestandsmanagement in SupplyChains, Books on Demand 2006
- Schönsleben. IntegralesLogistikmanagement, Springer, 1998

T 11.158 Course: Handling Characteristics of Motor Vehicles I [T-MACH-105152]

Responsible: Dr.-Ing. Hans-Joachim Unrau
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2113807	Handling Characteristics of Motor Vehicles I	2 SWS	Lecture (V)	Unrau
Exams					
SS 2019	76-T-MACH-105152	Handling Characteristics of Motor Vehicles I		Prüfung (PR)	Unrau

Competence Certificate
Verbally

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

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

V Handling Characteristics of Motor Vehicles I
2113807, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. Problem definition: Control loop driver - vehicle - environment (e.g. coordinate systems, modes of motion of the car body and the wheels)

2. Simulation models: Creation from motion equations (method according to D'Alembert, method according to Lagrange, programme packages for automatically producing of simulation equations), model for handling characteristics (task, motion equations)

3. Tyre behavior: Basics, dry, wet and winter-smooth roadway

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

Literature
1. Willumeit, H.-P.: Modelle und Modellierungsverfahren in der Fahrzeugdynamik,
B. G. Teubner Verlag, 1998

2. Mitschke, M./Wallentowitz, H.: Dynamik von Kraftfahrzeugen, Springer-Verlag, Berlin, 2004

3. Gnadler, R.; Unrau, H.-J.: Reprint collection to the lecture Handling Characteristics of Motor Vehicles I

T 11.159 Course: Handling Characteristics of Motor Vehicles II [T-MACH-105153]

Responsible: Dr.-Ing. Hans-Joachim Unrau
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114838	Handling Characteristics of Motor Vehicles II	2 SWS	Lecture (V)	Unrau
Exams					
SS 2019	76-T-MACH-105153	Handling Characteristics of Motor Vehicles II		Prüfung (PR)	Unrau

Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

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

V Handling Characteristics of Motor Vehicles II
2114838, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. Vehicle handling: Bases, steady state cornering, steering input step, single sine, double track switching, slalom, cross-wind behavior, uneven roadway

2. stability behavior: Basics, stability conditions for single vehicles and for vehicles with trailer

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

Literature
1. Zomotor, A.: Fahrwerktechnik: Fahrverhalten, Vogel Verlag, 1991
2. Mitschke, M./Wallentowitz, H.: Dynamik von Kraftfahrzeugen, Springer-Verlag, Berlin, 2004

3. Gnadler, R. Unrau, H.-J.: Reprint collection to the lecture Handling Characteristics of Motor Vehicles II

T 11.160 Course: Hands-on BioMEMS [T-MACH-106746]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

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

Events					
SS 2019	2143874	Hands-on BioMEMS	2 SWS	Lecture (V)	Guber
WS 19/20	2143874	Hands-on BioMEMS	2 SWS	Lecture (V)	Rajabi, Guber

Competence Certificate
Oral presentation and discussion (30 Min.)

Prerequisites
none

T 11.161 Course: Heat and Mass Transfer [T-MACH-105292]

Responsible: Prof. Dr.-Ing. Henning Bockhorn
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each term	1

Events					
SS 2019	3122512	Heat and Mass Transfer	2 SWS	Lecture (V)	Bockhorn
WS 19/20	2165512	Heat and mass transfer	2 SWS	Lecture (V)	Maas
Exams					
SS 2019	76-T-MACH-105292	Heat and Mass Transfer		Prüfung (PR)	Maas

Competence Certificate
Written exam, 3 h

Prerequisites
none

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

V Heat and mass transfer
2165512, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

- Steady and unsteady heat transfer in homogenous materials; Plates, pipe sections and sperical shells
- Molecular diffusion in gases; analogies between heat conduction and mass diffusion
- Convective, forced heat transfer in pipes/channels and around plates and profiles.
- Convective mass transfer, heat-/mass transfer analogy
- Multi phase convective heat transfer (ceondensation, evaporation)
- Radiative heat transfer

Annotation
Compulsory elective subject: 5 LP

Workload
General attendance: 22.5 h

Self-study: 97.5 h

Literature

- Maas; Vorlesungsskript "Wärme- und Stoffübertragung"
- Baehr, H.-D., Stephan, K.: "Wärme- und Stoffübertragung" , Springer Verlag, 1993
- Incropera, F., DeWitt, F.: "Fundamentals of Heat and Mass Transfer" , John Wiley & Sons, 1996
- Bird, R., Stewart, W., Lightfoot, E.: "Transport Phenomena" , John Wiley & Sons, 1960

T 11.162 Course: Heat Transfer in Nuclear Reactors [T-MACH-105529]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189907	Flow and heat transfer in nuclear reactors	2 SWS	Lecture (V)	Cheng
Exams					
SS 2019	76-T-MACH-105529	Heat Transfer in Nuclear Reactors		Prüfung (PR)	Cheng

Competence Certificate
oral exam, 20 min

Prerequisites
none

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

V Flow and heat transfer in nuclear reactors

Lecture (V)

2189907, WS 19/20, 2 SWS, Language: English, Open in study portal

Notes

1. Reactor types and thermal-hydraulic design criteria
2. Heat transfer processes and modeling
3. Pressure drop calculation
4. Temperature distribution in nuclear reactor
5. Numerical analysis methods for nuclear reactor thermal-hydraulics

Learning Content

1. Reactor types and thermal-hydraulic design criteria
2. Heat transfer processes and modeling
3. Pressure drop calculation
4. Temperature distribution in nuclear reactor
5. Numerical analysis methods for nuclear reactor thermal-hydraulics

Workload
Time of attendance: 21 hours
Self-study: 99 hours

Literature

1. L.S. Tong, J. Weisman, Thermal-hydraulics of pressurized water reactors, American Nuclear Society, La Grande Park, Illinois, USA
2. R.T. Lahey, F.J. Moody, The Thermal-Hydraulics of a Boiling Water Nuclear Reactor, 2nd edition, ANS, La Grande Park, Illinois, USA, 1993

T 11.163 Course: Heatpumps [T-MACH-105430]

Responsible: Prof. Dr. Ulrich Maas
Heiner Wirbser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102635 - Major Field: Engineering Thermodynamics
M-MACH-102648 - Major Field: Energy Technology for Buildings

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2166534	Heatpumps	2 SWS	Lecture (V)	Wirbser
Exams					
SS 2019	76-T-MACH-105430	Heatpumps		Prüfung (PR)	Maas, Wirbser

Competence Certificate
Oral exam (20 min)

Prerequisites
none

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

V Heatpumps
2166534, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
The aim of this lecture is to promote heat pumps as heating systems for small an medium scale facilities and to discuss their advantages as well as their drawbacks. After considering the actual energy situation and the political requirements the different aspects of heat pumps are elucidated. The requirements concerning heat sources, the different components and the various types of heat pumps are discussed. In addition ecological and economical aspects are taken into consideration. The coupling of heat pumps with heat accumulators in heating systems will also be part of the lecture.

Workload
Regular attendance: 21 hours

Self-study: 100 hours

Literature
Vorlesungsunterlagen

Bach, K.: Wärmepumpen, Bd. 26 Kontakt und Studium, Lexika Verlag, 1979

Kirn, H., Hadenfeldt, H.: Wärmepumpen, Bd. 1: Einführung und Grundlagen, Verlag C. F. Müller, 1987

von Cube, H.L.: Lehrbuch der Kältetechnik, Verlag C.F. Müller, Karlsruhe, 1975.

von Cube, H.L., Steimle,F.: Wärmepumpen, Grunglagen und Praxis VDI-Verlag, Düsseldorf, 1978.

T 11.164 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-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	5	Each term	2

Events					
WS 19/20	2183721	High Performance Computing	2 SWS	Lecture / Practice (VÜ)	Nestler, Selzer, Hötzer

Competence Certificate
At the end of the semester, there will be a written exam (90 min).

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

regular participation in the additionally offered computer exercises

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

V High Performance Computing
2183721, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

Slides of the lecture, excercise sheets, solution files of the computer excercises.

Notes
Topics of the high performance computing courde are:

- achitectures of parallel platforms
- parallel programming models
- performance analysis of concurrent programs
- parallelization models
- MPI and OpenMP
- onte-Carlo method
- 1D & 2D heat diffusion
- raycasting
- n-body problem
- simple phase-field models

The student

- can explain the foundations and strategies of parallel programming
- can efficiently apply high performance computers for simulations by elaborating respective parallelisation techniques.
- has an overview of typical applications and the specific requirements for parallelization.
- knows the concepts of parallelisation and is capable to apply these to efficiently use high performance computing resources and the growing performance of multi core processors in science and industry.
- has experiences in programming of parallel algorithms through integrated computer exercises.

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

We regularly discuss excercises at the computer.

At the end of the semester, there will be a written exam.

Learning Content
Topics of the high performance computing course are:

- achitectures of parallel platforms
- parallel programming models
- key figures and performance analysis of concurrent programs
- parallelization models
- MPI and OpenMP
- parallel I/O (MPI-I/O)
- vector processing (SIMD)
- cache coherence protocols
- interconnection networks
- simple phase-field models
-

Workload
regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

Literature

1. Lecture Notes; Problem Sheets; Program templates
2. Foundations of Multithreaded, Parallel, and Distributed Programming, Gregory R. Andrews; Addison Wesley 2000

T 11.165 Course: High Performance Powder Metallurgy Materials [T-MACH-102157]

Responsible: Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2126749	Advanced powder metals	2 SWS	Lecture (V)	Schell
Exams					
SS 2019	76-T-MACH-102157	High Performance Powder Metallurgy Materials		Prüfung (PR)	Schell
WS 19/20	76-T-MACH-102157	High Performance Powder Metallurgy Materials		Prüfung (PR)	Schell

Competence Certificate
oral exam, 20- 30 min

Prerequisites
none

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

V Advanced powder metals

2126749, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
The lecture gives an overview on production, properties and application of structural and functional powder metallurgy material. The following groups of materials are presented: PM High Speed Steels, Cemented Carbides, PM Metal Matrix Composites, PM Specialities, PM Soft Magnetic and Hard Magnetic Materials.

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

Literature

- W. Schatt ; K.-P. Wieters ; B. Kieback. ".Pulvermetallurgie: Technologien und Werkstoffe", Springer, 2007
- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
- F. Thümmler, R. Oberacker. "Introduction to Powder Metallurgy", Institute of Materials, 1993

T 11.166 Course: High Temperature Materials [T-MACH-105459]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102649 - Major Field: Advanced Materials Modelling

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2174600	High Temperature Structural Materials	2 SWS	Lecture (V)	Heilmaier
Exams					
SS 2019	76-T-MACH-105459	High Temperature Materials		Prüfung (PR)	Heilmaier, Lang
WS 19/20	76-T-MACH-105459	High Temperature Materials		Prüfung (PR)	Heilmaier, Lang

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

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

V High Temperature Structural Materials
2174600, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

- Phenomenology of High Temperature Deformation
- Deformation Mechanisms
- High Temperature Structural Materials

learning objectives:

Students are able to

- Define properly the term "high temperature" with respect to materials
- Describe the shape of the creep curve based on underlying deformation mechanisms
- Rationalize the influence of relevant parameters such as temperature, stress, microstructure on the high temperature deformation behavior
- Develop strategies for improving creep resistance of alloys via modifying their composition
- Select properly industrially relevant high temperature structural materials for various applications

requirements:

Relevant Bachelor degree, **Recommendations:** None

workload:

Regular attendance 28 h, self study 92 h

Learning Content

- Phenomenology of High Temperature Deformation
- Deformation Mechanisms
- High Temperature Structural Materials

Workload
Regular attendance 28 h, self study 92 h

Literature
M.E. Kassner, Fundamentals of Creep in Metals and Alloys, Elsevier, Amsterdam, 2009

T 11.167 Course: HoC lectures [T-MACH-106377]

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

Part of: M-MACH-102824 - Key Competences

Type	Credits	Recurrence	Version
Completed coursework	2	Each term	1

Competence Certificate
See course

Prerequisites
none

T 11.168 Course: Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy [T-INFO-101262]

Responsible: Prof. Dr.-Ing. Rüdiger Dillmann
Prof. Uwe Spetzger

Organisation: KIT Department of Informatics

Part of: M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Oral examination	3	Each term	1

Events					
SS 2019	24678	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	2 SWS	Lecture (V)	Spetzger
WS 19/20	24139	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	2 SWS	Lecture (V)	Spetzger
Exams					
SS 2019	7500145	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy		Prüfung (PR)	Dillmann

T 11.169 Course: Human Factors Engineering I [T-MACH-105518]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2109035	Human Factors Engineering I: Ergonomics	2 SWS	Lecture (V)	Deml
Exams					
SS 2019	76-T-MACH-105518	Human Factors Engineering I		Prüfung (PR)	Deml

Competence Certificate
written exam, 60 minutes

The exams are only offered in German!

Prerequisites
none

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

V Human Factors Engineering I: Ergonomics

Lecture (V)

2109035, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester, **until 2019/12/05**, on Wednesday and Thursday.

In the second half of the semester, **beginning with 2019/12/11**, the course "Human Factors Engineering II: Work Organisation" takes place on Wednesday and Thursday.

Content of teaching:

1. Principles of human work
2. Behavioural-science data acquisition
3. workplace design
4. work environment design
5. work management
6. labour law and advocay groups

Learning target:

The students acquire a basic knowledge in the field of ergonomics:

- They are able to consider cognitive, physiological, anthropometric, and safety technical aspects in order to design workplaces ergonomically.
- Just as well they know physical and psycho-physical fundamentals (e. g. noise, lighting, climate) in the field of work-environmental design.
- Furthermore the students are able to evaluate workplaces by knowing and being able to apply essential methods of time studies and payment systems.
- Finally, they get a first, overall insight into the German labour law as well as into the organisation of advocacy groups beyond companies.

Further on the participants get to know basic methods of behavioral-science data acquisition (e. g. eye-tracking, ECG, dual-task-paradigm).

Learning Content

1. Principles of human work
2. Behavioural-science data acquisition
3. workplace design
4. work environment design
5. work management
6. labour law and advocay groups

Workload

The amount of work accounts for 120 h (=4 ECTS).

Literature

The lecture material is available on ILIAS for download.

T 11.170 Course: Human Factors Engineering II [T-MACH-105519]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102596 - Compulsory Elective Subject Economics/Law
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2109036	Human Factors Engineering II: Work Organisation	2 SWS	Lecture (V)	Deml
Exams					
SS 2019	76-T-MACH-105519	Human Factors Engineering II		Prüfung (PR)	Deml

Competence Certificate
written exam, 60 minutes

The exams are only offered in German!

Prerequisites
none

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

V Human Factors Engineering II: Work Organisation

2109036, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content of teaching:

1. Fundamentals of work organization
2. Empirical research methods
3. Individual level
    - personnel selection
    - personnel development
    - personnel assessment
    - work satisfaction/motivation
4. Group level
    - interaction and communication
    - management of employees
    - team work
5. Organizational level
    - structural organization
    - process organization
    - production organization

Learning target:

The students gain a first insight into empirical research methods (e. g. experimental design, statistical data evaluation). Particularly, they acquire a basic knowledge in the field of work organisation:

- *Organizational level*. Within this module the students gain also a fundamental knowledge in the field of structural, process, and production organization.
- *Group level*. Besides, they get to know basic aspects of industrial teamwork and they know relevant theories in the field of interaction and communication, the management of employees as well as work satisfaction and motivation.
- *individual level*. Finally, the students get to know also methods in the field of personnel selection, development, and assessment.

Learning Content

1. Fundamentals of work organization
2. Empirical research methods
3. Individual level
    - personnel selection
    - personnel development
    - personnel assessment
    - work satisfaction/motivation
4. Group level
    - interaction and communication
    - management of employees
    - team work
5. Organizational level
    - structural organization
    - process organization
    - production organization

Workload
The amount of work is 120 h (=4 ECTS).

Literature
The lecture material is available on ILIAS for download.

T 11.171 Course: Human Factors Engineering III: Empirical research methods [T-MACH-105830]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102600 - Major Field: Man - Technology - Organisation

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

Events					
SS 2019	2110036	Human Factors Engineering III: Empirical research methods	2 SWS	Lecture / Practice (VÜ)	Deml

Competence Certificate
Scientific report (about 6 pages), poster, and presentation

Prerequisites
In order to attend this lecture, it is necessary having completed "Arbeitswissenschaft I" or "Arbeitswissenschaft II" successfully.

Modeled Conditions
You have to fulfill one of 2 conditions:

1. The course T-MACH-105518 - Human Factors Engineering I must have been passed.
2. The course T-MACH-105519 - Human Factors Engineering II must have been passed.

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

V Human Factors Engineering III: Empirical research methods

Lecture / Practice (VÜ)

2110036, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
The aim of the event is for the participants to know and be able to apply research methods in the field of ergonomics. The participants will get an introduction into the basics of experimental design and learn about essential methods of data collection and statistical data evaluation. Subsequently, the participants will carry out, evaluate and present their own experimental studies on topics such as "Digital Human Models", "Eyetracking" or "Driving Simulation" in the form of laboratory internships.

Translated with www.DeepL.com/Translator

T 11.172 Course: Human-Machine-Interaction [T-INFO-101266]

Responsible: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102614 - Major Field: Mechatronics

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	2

Events					
SS 2019	24659	Human-Computer-Interaction	2 SWS	Lecture (V)	Beigl
Exams					
SS 2019	7500048	Human-Machine-Interaction		Prüfung (PR)	Beigl
WS 19/20	7500076	Human-Machine-Interaction		Prüfung (PR)	Beigl

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-INFO-106257 - Human-Machine-Interaction Pass must have been passed.

T 11.173 Course: Human-Machine-Interaction Pass [T-INFO-106257]

Responsible: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102614 - Major Field: Mechatronics

Type	Credits	Recurrence	Version
Completed coursework	0	Each summer term	1

Events					
SS 2019	2400095	Human-Computer-Interaction	1 SWS	Practice (Ü)	Beigl, Exler
SS 2019	24659	Human-Computer-Interaction	2 SWS	Lecture (V)	Beigl
Exams					
SS 2019	7500121	Human-Machine-Interaction		Prüfung (PR)	Beigl

T 11.174 Course: Humanoid Robots - Practical Course [T-INFO-105142]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Examination of another type	3	Each winter term	1

Events					
WS 19/20	24890	Humanoid Robotics Laboratory	2 SWS	Practical course (P)	Asfour, Pohl, Ottenhaus
Exams					
WS 19/20	7500149	Humanoid Robots - Practical Course		Prüfung (PR)	Asfour

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

V Humanoid Robotics Laboratory

24890, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
In this block course, a complex task will be implemented in a small team. The exercise addresses algorithmic questions in the context of humanoid robotics, such as active perception with stereo or depth cameras, grasping and manipulation planning, action representation with DMS, HMMs or splines, reproduction of motions, or active balancing with humanoid robots.

Workload
90 h

T 11.175 Course: Human-oriented Productivity Management: Personnel Management [T-MACH-106374]

Responsible: Dr.-Ing. Patricia Stock
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2109021	Human-oriented Productivity Management: Personnel Management	2 SWS	Block (B)	Stock

Competence Certificate
oral exam (approx. 20 min)

The exam is offered in German only!

Prerequisites
Timely pre-registration in ILIAS, since participation is limited.

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

V Human-oriented Productivity Management: Personnel Management

2109021, WS 19/20, 2 SWS, Language: German, Open in study portal

Block (B)

Notes

1. Introduction: change of the working world, work organisation of successful companies, requirements for Industrial Engineering
2. Human-oriented Productivity Management
3. Organisation of enterprises:
   - Process-oriented work organisation
   - Operational and organisational structure
   - Holistic production systems
4. Basics of personnel management:
   - Identification of available capacity & capacity requirements
   - Management of working time
   - Types of mobile working
5. Systematic design of the human-resource allocation
6. Case study (group work)
7. Presentation of the solutions developed

- Knowledge in Production Management/Industrial Engineering is required
- Knowledge of Work Science and Economics is helpful

Learning target:

The student it capable ...

- to describe and explain the current megatrends, resulting challenges for enterprises as well as operational success factors
- to explain tasks and methods of human-oriented productivity management
- to analyse an existing working system
- to determine the available capacity and the capacity needed of a work system
- to use basic methods and tools of personnel management and to evaluate existing solutions
- to systematically design and organise the employment of staff

Annotation

- Compact course (one week full-time)
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required

Literature

Handout and literature is available on ILIAS for download.

T 11.176 Course: Hybrid and Electric Vehicles [T-ETIT-100784]

Responsible: Dr.-Ing. Klaus-Peter Becker

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102614 - Major Field: Mechatronics

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2306321	Hybrid and Electric Vehicles	2 SWS	Lecture (V)	Doppelbauer
WS 19/20	2306323	Tutorial for 2306323 Hybrid and Electric Vehicles	1 SWS	Practice (Ü)	Doppelbauer
Exams					
SS 2019	7306321	Hybrid and Electric Vehicles		Prüfung (PR)	Doppelbauer

Prerequisites
none

T 11.177 Course: Hydraulic Fluid Machinery [T-MACH-105326]

Responsible: Dr. Balazs Pritz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines

Type	Credits	Recurrence	Version
Oral examination	8	Each summer term	1

Events					
SS 2019	2157432	Hydraulic Fluid Machinery	4 SWS	Lecture (V)	Pritz
Exams					
SS 2019	76-T-MACH-105326	Hydraulic Fluid Machinery		Prüfung (PR)	Gabi

Competence Certificate
oral exam, 40 min.

Prerequisites
None.

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

V Hydraulic Fluid Machinery
2157432, SS 2019, 4 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

1. Introduction
2. Basic equations
3. System analysis
4. Elementary Theory (Euler's equation of Fluid Machinery)
5. Operation and Performance Characteristics
6. Similarities, Specific Values
7. Control technics
8. Wind Turbines, Propellers
9. Cavitation
10. Hydrodynamic transmissions and converters

Workload
regular attendance: 56 hours
self-study: 150 hours

preparation for exam: 40 hours

Literature

1. Fister, W.: Fluidenergiemaschinen I & II, Springer-Verlag
2. Bohl, W.: Strömungsmaschinen I & II . Vogel-Verlag
3. Gülich, J.F.: Kreiselpumpen, Springer-Verlag
4. Pfleiderer, C.: Die Kreiselpumpen. Springer-Verlag
5. Carolus, T.: Ventilatoren. Teubner-Verlag
6. Kreiselpumpenlexikon. KSB Aktiengesellschaft
7. Zierep, J., Bühler, K.: Grundzüge der Strömungslehre. Teubner-Verlag

T 11.178 Course: Hydrodynamic Stability: From Order to Chaos [T-MACH-105425]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2154437	Hydrodynamic Stability: From Order to Chaos	2 SWS	Lecture (V)	Class
Exams					
SS 2019	76-T-MACH-105425	Hydrodynamic Stability: From Order to Chaos		Prüfung (PR)	Class

Competence Certificate
oral exam, Duration: 30 minutes

Auxiliary means: none

Prerequisites
The partial performance number T-MACH-108846 - "Stability: From Order to Chaos" (Nat/Inf/Etit) must not be startet or completed. The partial services T-MACH-108846 - "Stability: From Order to Chaos" (Nat/Inf/Etit) and T-MACH-105425 - "Hydrodynamic Stability: From Order to Chaos" are mutually exclusive.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108846 - Stability: from order to chaos must not have been started.

Recommendation
Fluid Mechanics (T-MACH-105207)

Mathematical Methods in Fluid Mechanics (T-MACH-105295)

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

V Hydrodynamic Stability: From Order to Chaos

Lecture (V)

2154437, SS 2019, 2 SWS, Language: German/English, Open in study portal

Description
Media:

Black board

Notes

The studends can apply the analytic and numerical methods for an evaluation of stability properties of hydrodynamic systems. The are qualified to discuss the characteristic influence of parameter changes (e.g. Renolds number) on the calculated results with respect to the flow character and properties (e.g. transition laminar/turbulent flow).

Increasing a control parameter of a thermohydraulic system, e.g. the Reynolds number, the initial flow pattern (e.g. stationary flow) can be replaced by a different pattern (e.g. turbulent flow).

Typical hydrodynamic instabilities are summarized in the lecture.
The systematic analysis of thermohydraulic stability problems is developed for the case of Rayleigh-Bernard convection (fluid layer heated from below) and selected examples from fluid dynamics.

Covered is:

- linear stability analysis: determine limiting control parameter value up to which the basic flow pattern is stable against small perturbations.
- nonlinear reduced order modeling, capable to characterize more complex flow patterns
- Lorenz system: a generic system exhibiting chaotic behavior

Learning Content

Increasing a control parameter of a thermohydraulic system, e.g. the Reynolds number, the initial flow pattern (e.g. stationary flow) can be replaced by a different pattern (e.g. turbulent flow).

Typical hydrodynamic instabilities are summarized in the lecture.
The systematic analysis of thermohydraulic stability problems is developed for the case of Rayleigh-Bernard convection (fluid layer heated from below) and selected examples from fluid dynamics.

Covered is:

- linear stability analysis: determine limiting control parameter value up to which the basic flow pattern is stable against small perturbations.
- nonlinear reduced order modeling, capable to characterize more complex flow patterns
- Lorenz system: a generic system exhibiting chaotic behavior

Annotation

Lecture also offered as a block-lecture within the AREVA Nuclear Professional School (www.anps.kit.edu)

Workload

regulare attendance: 21h

self-study: 99h

Literature

Script

T 11.179 Course: Hydrogen in Materials [T-MACH-108853]

Responsible: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2173583	Hydrogen in Materials	2 SWS	Lecture (V)	Pundt
Exams					
SS 2019	76-T-MACH-108853	Hydrogen in Materials		Prüfung (PR)	Pundt
WS 19/20	76-T-MACH-108853	Hydrogen in Materials		Prüfung (PR)	Pundt

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Recommendation
Materials Science or Materials Physics and Metals

T 11.180 Course: Hydrogen Technologies [T-MACH-105416]

Responsible: Dr. Thomas Jordan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2170495	Hydrogen Technologies	2 SWS	Lecture (V)	Jordan
Exams					
SS 2019	76-T-MACH-105416	Hydrogen Technologies		Prüfung (PR)	Jordan

Competence Certificate
oral exam, Duration: approximately 30 minutes

Auxiliary: no tools or reference materials may be used during the exam

Prerequisites
none

Recommendation
Fundamentals Thermodynamics

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

V Hydrogen Technologies — Lecture (V)
2170495, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
The course content is the cross-cutting issue of hydrogen as energy carrier. After successful participation the students may reflect on the fundamental technological basis of an energy system using predominantly hydrogen as an energy carrier or energy storage. Based on this knowledge they may objectify the principle idea of an hydrogen economy.

The students know the fundamental physical and chemical properties of hydrogen and may apply their knowledge on thermodynamics to compare efficiencies of different solutions with hydrogen. They can list, compare and evaluate established and future solutions for production, storage and distribution of hydrogen. They can explain advantages and disadvantages of using hydrogen in conventional combustion processes versus using hydrogen in different fuel cells. In particular the can describe the specific safety aspects related to hydrogen, compare them with other energy vectors and evaluate different measures for risk mitigation.

- Basic concepts
- Production
- Transport and storage
- Application
- Safety aspects

Learning Content
Basic concepts
Production
Transport and storage
Application
Safety aspects

Annotation
Recommendation: Fundamentals Thermodynamics

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

Literature
Ullmann's Encyclopedia of Industrial Chemistry
Hydrogen and Fuel Cells, Ed. S. Stolten, Wiley-VCH, 2010, ISBN 978-3-527-32711-9

T 11.181 Course: Ignition systems [T-MACH-105985]

Responsible: Dr.-Ing. Olaf Toedter
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Version
Oral examination	4	1

Events					
WS 19/20	2133125	Ignition systems	2 SWS	Lecture (V)	Toedter
Exams					
WS 19/20	76-T-MACH-105985	Ignition systems		Prüfung (PR)	Koch

Competence Certificate
oral exam, 20 min

Prerequisites
none

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

V Ignition systems

2133125, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

- Ignition Process
- Spark Ignition
- Principle of Spark Ignition Systems
- Limits of Spark Ignition
- New Develpoments of Spark Ignition Systems
- New an Alternative Ignition Systems

T 11.182 Course: Industrial Aerodynamics [T-MACH-105375]

Responsible: Prof. Dr.-Ing. Thomas Breitling
Prof. Dr.-Ing. Bettina Frohnapfel

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153425	Industrial aerodynamics	2 SWS		Breitling
Exams					
WS 19/20	76-T-MACH-105375	Industrial Aerodynamics		Prüfung (PR)	Breitling

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

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

V Industrial aerodynamics
2153425, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Power Point

Notes
This compact lecture deals with flow, mixing and combustion phenomena with significance in vehicle development. A special focus is set on the optimization of external car and truck aerodynamics, thermal comfort in passenger compartments, analyses of cooling flows and improvement of charge motion, mixing and combustion in piston engines. These fields are explained in their phenomenology, the corresponding theories are discussed and the tools for measurement and simulation are introduced and demonstrated. The focus of this lecture is on industry relevant methods for analyses and description of forces, flow structures, turbulence, flows with heat transfer and phase transition and reactive flows. In addition an introduction to modern methods in accuracy control and efficiency improvement of numerical methods for industrial use is given. The integration and interconnection of the methods in the development processes are discussed examplary.
An excursion to the Daimler AG wind tunnel and the research and development centers is planned.

- Industrial flow measurement techniques
- Flow simulation and control of numerical errors, turbulence modeling
- Cooling flows
- Flow mixing and combustation at direct injected Diesel engines
- Flow mixing and combustation at gasoline engine
- Vehicle aerodynamics
- HVAC-Systems and thermal comfort
- Aeroacoustics

Students can describe the different challenges of aerdynamical flow that occur in vehicles. They are qualified to analyze external flows around the vehicles, flows in the passenger compartments (thermal comfort), as well as cooling flows, charge motion, mixing and combustion processes in the engine.

Learning Content
This compact lecture deals with flow, mixing and combustion phenomena with significance in vehicle development. A special focus is set on the optimization of external car and truck aerodynamics, thermal comfort in passenger compartments, analyses of cooling flows and improvement of charge motion, mixing and combustion in piston engines. These fields are explained in their phenomenology, the corresponding theories are discussed and the tools for measurement and simulation are introduced and demonstrated. The focus of this lecture is on industry relevant methods for analyses and description of forces, flow structures, turbulence, flows with heat transfer and phase transition and reactive flows. In addition an introduction to modern methods in accuracy control and efficiency improvement of numerical methods for industrial use is given. The integration and interconnection of the methods in the development processes are discussed examplary.
An excursion to the Daimler AG wind tunnel and the research and development centers is planned.

- Industrial flow measurement techniques
- Flow simulation and control of numerical errors, turbulence modeling
- Cooling flows
- Flow mixing and combustation at direct injected Diesel engines
- Flow mixing and combustation at gasoline engine
- Vehicle aerodynamics
- HVAC-Systems and thermal comfort
- Aeroacoustics

Annotation
Block course with limited number of participants, registration in the secretary's office required. See details at www.istm.kit.edu

Workload
attendance: 22.5h

self-study: 100h

Literature
Script

T 11.183 Course: Information Engineering [T-MACH-102209]

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

Part of: M-MACH-102613 - Major Field: Lifecycle Engineering

Type	Credits	Recurrence	Version
Examination of another type	3	Each term	2

Events					
SS 2019	2122014	Information Engineering	2 SWS	Seminar (S)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102209	Information Engineering		Prüfung (PR)	Ovtcharova

Competence Certificate
Alternative exam assessment (written composition and speech)

Prerequisites
None

T 11.184 Course: Information Processing in Mechatronic Systems [T-MACH-105328]

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

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102624 - Major Field: Information Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2105022	Information Processing in Mechatronic Systems	2 SWS	Lecture (V)	Kaufmann

Competence Certificate
Written exam (Duration: 1 h)

Prerequisites
none

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

V Information Processing in Mechatronic Systems

2105022, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content:

Information processing components – consisting of sensors, actors, hardware and software – are of essential importance for the implementation of mechatronic functions.

Based on requirements on information processing in mechatronic systems typical hardware and software solutions are examined. Characteristics, advantages, disadvantages and application areas are discussed. Solutions are examined regarding real-time capabilities, dependability, safety and fault tolerance. Bus communication in mechatronic systems is examined. Description methods and several approaches of functional description are considered. An approach on the development of information processing components is developed. Lecture topics are complemented by practical examples.

Outline:

- Requirements on information processing components,
- Characteristics of information processing components
- Real-time capabilities, dependability, safety and fault tolerance
- Architectures of information processing components
- Communication in mechatronic systems
- Descriptive models und functional description
- Development of information processing components
- Software quality

Learning objectives:

Students have fundamental knowledge about selection, conceptual design and development of information processing components in mechatronic systems.

Learning Content

Information processing components – consisting of sensors, actors, hardware and software – are of essential importance for the implementation of mechatronic functions.

Based on requirements on information processing in mechatronic systems typical hardware and software solutions are examined. Characteristics, advantages, disadvantages and application areas are discussed. Solutions are examined regarding real-time capabilities, dependability, safety and fault tolerance. Bus communication in mechatronic systems is examined. Description methods and several approaches of functional description are considered. An approach on the development of information processing components is developed. Lecture topics are complemented by practical examples.

Outline:

- Requirements on information processing components,
- Characteristics of information processing components
- Real-time capabilities, dependability, safety and fault tolerance
- Architectures of information processing components
- Communication in mechatronic systems
- Descriptive models und functional description
- Development of information processing components
- Software quality

Workload

General attendance: 21 h

Self-study: 99 h

T 11.185 Course: Information Processing in Sensor Networks [T-INFO-101466]

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102624 - Major Field: Information Technology

Type	Credits	Recurrence	Version
Oral examination	6	Irregular	1

Events					
WS 19/20	24102	Information Processing in Sensor Networks	3 SWS	Lecture (V)	Noack, Mayer, Hanebeck
Exams					
SS 2019	7500011	Information Processing in Sensor Networks		Prüfung (PR)	Hanebeck, Noack
WS 19/20	7500030	Information Processing in Sensor Networks		Prüfung (PR)	Noack, Hanebeck

T 11.186 Course: Information Systems and Supply Chain Management [T-MACH-102128]

Responsible: Dr. Christoph Kilger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102624 - Major Field: Information Technology
M-MACH-102625 - Major Field: Information Technology of Logistic Systems
M-MACH-102629 - Major Field: Logistics and Material Flow Theory

Type	Credits	Recurrence	Version
Oral examination	3	Each summer term	2

Events					
SS 2019	2118094	Information Systems in Logistics and Supply Chain Management	2 SWS	Lecture (V)	Kilger
Exams					
SS 2019	76-T-MACH-102128	Information Systems and Supply Chain Management		Prüfung (PR)	Mittwollen

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

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

V Information Systems in Logistics and Supply Chain Management

2118094, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

presentations

Learning Content
1) Overview of logistics systems and processes

2) Basic concepts of information systems and information technology

3) Introduction to IS in logistics: Overview and applications

4) Detailed discussion of selected SAP modules for logistics support

Annotation
none

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

Literature
Stadtler, Kilger: Supply Chain Management and Advanced Planning, Springer, 4. Auflage 2008

T 11.187 Course: Innovative Nuclear Systems [T-MACH-105404]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy
M-MACH-102610 - Major Field: Power Plant Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2130973	Innovative Nuclear Systems	2 SWS		Cheng
Exams					
SS 2019	76-T-MACH-105404	Innovative Nuclear Systems		Prüfung (PR)	Cheng

Competence Certificate
oral exam, 20 min

Prerequisites
none

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

V Innovative Nuclear Systems
2130973, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content

1. state of the art and development tendencies in nuclear systems
2. advanced concepts in light water cooled systems
3. new developments in fast reactors
4. development tendencies in gas-cooled plants
5. transmutation systems for waste management
6. fusionsystems

Workload
Time of attendance: 21 hours
Self-study: 100 hours

T 11.188 Course: Innvative Project [T-MACH-109185]

Responsible: Prof. Dr. Andreas Class
Prof. Dr. Orestis Terzidis

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104323 - Major Field: Innovation and Entrepreneurship

Type	Credits	Recurrence	Version
Examination of another type	6	Each winter term	1

Events					
WS 19/20	2169466	Innovative Project	3 SWS		Class, Terzidis

Competence Certificate
Students have to deliver pitch-talk supported by slides to convience a commity about their results. A fictive project proposal of 10 to 15 pages.

Prerequisites
none

Recommendation
Participates need to bring there own laptop with Skype installed.

Recommended English profiency äquivalent to:

- IELTS Academic test
  An overall band score of at least 6.5 (with no section lower than 5.5)
- University of Cambridge
  Certificate in Advanced English, CAE (grades A – C)
  Certificate of Proficiency in English, CPE (grades A – C)
- TOEFL Internet-based test, IBT
  A total score of at least 92, with a minimum score of 22 from the writing section

Annotation
The subject of the project is provided by industry partner or the innovation department from KIT or INP Grenoble. Representatives of industry partner will be addressee for the pitch-talk.

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

V Innovative Project
2169466, WS 19/20, 3 SWS, Language: English, Open in study portal

Notes
The lecture will be executed with the partner university INP Grenoble. Participates need to bring there own laptop with Skype installed. Teams of 2-3 students.

- Understand the physics of the technology of the invention considered in the project
- Understand the claims of the patent considered in the project
- Apply a structured technology application selection methodology.
- Student understand the methodology of TAS, which provides the background to become a TAS coach.
- Students are enabled to prepare a proposal for funding.

The TAS (technology application selection) methodology provides tools that help to successfully advance an invention with a low technology readiness level to a higher technology readiness level. Skills that are typically provided by a classical engineering education supports both the early phase of an invention where a deep basic understanding is required and the industrial exploration building on a first prototype. The gap that arises between the invention and its later industrialized application is rarely addressed, so that many inventions will not make it to the market. In the course, we practice bridging the technology gap for the case of a real invention provided by an industry partner or University. We experiment with teams consisting of team members located at different universities and from different disciplines.

The scenario addressed is an inventor who calls some of his friends within her/his personal network. The group will work remotely via video conference employing a structured TAS process. Creativity will be fertilized by teamwork and linking the invention to a selection of potential technologies. In an in-depth analysis of these links, each group narrows down their pool of ideas to one candidate. Finally, the group will try to convince the fellow teams (and the inventor) to support their idea. For this purpose, a pitch talk is prepared and delivered in front of all teams leading to a unique vote of all teams for one technology application. In addition the students prepare fictive proposals for start-up based on their TAS.

Learning Content
The TAS (technology application selection) methodology provides tools that help to successfully advance an invention with a low technology readiness level to a higher technology readiness level. Skills that are typically provided by a classical engineering education supports both the early phase of an invention where a deep basic understanding is required and the industrial exploration building on a first prototype. The gap that arises between the invention and its later industrialized application is rarely addressed, so that many inventions will not make it to the market. In the course, we practice bridging the technology gap for the case of a real invention provided by an industry partner or University. We experiment with teams consisting of team members located at different universities and from different disciplines.

The scenario addressed is an inventor who calls some of his friends within her/his personal network. The group will work remotely via video conference employing a structured TAS process. Creativity will be fertilized by teamwork and linking the invention to a selection of potential technologies. In an in-depth analysis of these links, each group narrows down their pool of ideas to one candidate. Finally, the group will try to convince the fellow teams (and the inventor) to support their idea. For this purpose, a pitch talk is prepared and delivered in front of all teams leading to a unique vote of all teams for one technology application. In addition the students prepare fictive proposals for start-up based on their TAS.

Annotation
The subject of the project is provided by industry partner or the innovation department from KIT or INP Grenoble. Representatives of industry partner will be addressee for the pitch-talk.

Workload
approx. 180 hours:

3 credit points - skype participation and resulting in TAS - 90 hours

1 credit point - pitch talk - 30 hours

2 credit points - for writting proposal - 60 hours

T 11.189 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-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2121001	Integrated Information Systems for engineers	3 SWS	Lecture / Practice (VÜ)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102083	Integrated Information Systems for Engineers		Prüfung (PR)	Ovtcharova, Elstermann

Competence Certificate
Oral examination 20 min.

Prerequisites
None

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

V Integrated Information Systems for engineers

2121001, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Learning Content

- Information systems, information management
- CAD, CAP and CAM systems
- PPS, ERP and PDM systems
- Knowledge management and ontology
- Process modeling

Workload
Regular attendance: 31,5 hours, self-study: 108 hours

Literature
Lecture slides

T 11.190 Course: Integrated Product Development [T-MACH-105401]

Responsible: Prof. Dr.-Ing. Albert Albers
Albers Assistenten

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102626 - Major Field: Integrated Product Development

Type	Credits	Recurrence	Version
Oral examination	16	Each winter term	1

Events					
WS 19/20	2145156	Integrated Product Development	4 SWS	Lecture (V)	Albers
WS 19/20	2145157	Workshop Product Development	4 SWS	Practice (Ü)	Albers, Mitarbeiter
WS 19/20	2145300	Project Work in Product Development	2 SWS	Others (sonst.)	Albers

Competence Certificate
oral examination (60 minutes)

Prerequisites
none

Annotation
Due to organizational reasons, the number of participants is limited. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK hompage from april to july. The selection itself is made by Prof. Albers in personal interviews.

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

V Integrated Product Development

Lecture (V)

2145156, WS 19/20, 4 SWS, Language: German, Open in study portal

Notes

Registration required in the previous summer semester. The lecture starts in first week of October.

Prerequisites:

The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and project work (2145300).

Due to organizational reasons, the number of participants is limited. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK hompage from april to july. The selection itself is made by Prof. Albers in personal interviews.

Recommendations:

none

Workload:

regular attendance: 84 h

self-study: 288 h

Examination:

oral examination (60 minutes)

combined examination of lectures, tutorials and project work

Course content:

organizational integration: integrated product engineering model, core team management and simultaneous engineering

informational integration: innovation management, cost management, quality management and knowledge management

personal integration: team coaching and leadership management

invited lectures

Learning objectives:

The Students are able to ...

- analyze and evaluate product development processes based on examples and their own experiences.
- plan, control and evaluate the working process systematically.
- choose and use suitable methods of product development, system analysis and innovation management under consideration of the particular situation.
- prove their results.
- develop complex technical solutions in a team and to present them to qualified persons as well as non-qualified persons
- to design overall product development processes under consideration of market-, customer- and company- aspects

V **Workshop Product Development** **Practice (Ü)**

2145157, WS 19/20, 4 SWS, Language: German, Open in study portal

Notes

Prerequisites:

The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and project work (2145300).

Due to organizational reasons, the number of participants is limited to 42 persons. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK hompage from april to july. The selection itself is made by Prof. Albers in personal interviews.

Recommendations:

none

Workload:

regular attendance: 84 h

self-study: 288 h

Examination:

lectures: 21 h

preparation to exam: 99 h

Course content:

problem solving: analysis techniques, creativity techniques and evaluation methods

professional skills: presentation techniques, moderation and teamcoaching

development tools: MS Project, Szenario-Manager & Pro/Engineer Wildfire

Learning objectives:

The theoretical background taught in the lecture, is deepened through methodworkshops, business games and case studies. The reflexion of the onself precedure allows for an applicability and practicability of the contents in the accompnying development project as well as for the career entry.

V **Project Work in Product Development** **Others (sonst.)**

2145300, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Participation only possible in combination with the lecture 2145156 'Integrated Product Development'.

Prerequisites:

The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and project work (2145300).

Due to organizational reasons, the number of participants is limited to 42 persons. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK hompage from april to july. The selection itself is made by Prof. Albers in personal interviews.

Recommendations:

none

Workload:

regular attendance: 21 h

self-study: 99 h

Examination:

oral examination (60 minutes)

combined examination of lectures, tutorials and project work

Course content:

The project work begins with the early stages of product development, i.e. the identification of market trends and needs. Based on this information the students develop scenarios for future markets and create product profiles, which describe the customers and their demands without anticipating possible product solutions. After having passed several following milestones for ideas, concepts and designs, virtual prototypes and function prototypes are presented to an audience.
The project work is supported by coaching through skilled faculty staff. Additionally weekly tutorials, respectively workshops are given. For doing the project the teams gain access to team workspaces featuring IT-infrastructure and relevant software, such as office, CAD or FEA. Further on the teams learn how team cooperation and knowledge management can be supported in design project by using a wiki system.s

Learning objectives:

The center of "Integrated Product Development" constitutes itself in the development of a technical product within independent working student teams on the basis of the market situation up to virtual and real prototypes. Thereby the integrate treatment of the product development process is of importance. The project teams hereby represent development departments of medium sized companies, in which the presented methods and tools are field - experienced applied and ideas are transformed into concrete product models.
For the preparation of this development project the basics of 3D-CAD-modelling (Pro/ENGINEER) as well as different tools and methods of creative designing, of sketching and solution finding are mediated in workshops. Special events impart an insight of presentation techniques and the meaning of technical design.

T 11.191 Course: Integrated Production Planning in the Age of Industry 4.0 [T-MACH-108849]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	8	Each summer term	1

Events					
SS 2019	2150660	Integrated Production Planning in the Age of Industry 4.0	6 SWS	Lecture / Practice (VÜ)	Lanza
Exams					
SS 2019	76-T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0		Prüfung (PR)	Lanza

Competence Certificate
Oral Exam (40 min)

Prerequisites
"T-MACH-109054 - Integrierte Produktionsplanung im Zeitalter von Industrie 4.0" as well as "T-MACH-102106 Integrierte Produktionsplanung" must not be commenced.

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

V Integrated Production Planning in the Age of Industry 4.0

Lecture / Practice (VÜ)

2150660, SS 2019, 6 SWS, Language: German, Open in study portal

Description
Media:

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

Notes

Integrated production planning in the age of industry 4.0 will be taught in the context of this engineering science lecture. In addition to a comprehensive introduction to Industry 4.0, the following topics will be addressed at the beginning of the lecture:

- Basics, history and temporal development of production
- Integrated production planning and integrated digital engineering
- Principles of integrated production systems and further development with Industry 4.0

Building on this, the phases of integrated production planning are taught in accordance with VDI Guideline 5200, whereby special features of parts production and assembly are dealt with in the context of case studies:

- Factory planning system
- Definition of objectives
- Data collection and analysis
- Concept planning (structural development, structural dimensioning and rough layout)
- Detailed planning (production planning and control, fine layout, IT systems in an industry 4.0 factory)
- Preparation and monitoring of implementation
- Start-up and series support

The lecture contents are rounded off by numerous current practical examples with a strong industry 4.0 reference. Within the exercises the lecture contents are deepened and applied to specific problems and tasks.

Learning Outcomes:

The students ...

- can discuss basic questions of production technology.
- are able to apply the methods of integrated production planning they have learned about to new problems.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about for a specific problem.
- can apply the learned methods of integrated production planning to new problems.
- can use their knowledge targeted for efficient production technology.

Workload:

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

Learning Content

Integrated production planning in the age of industry 4.0 will be taught in the context of this engineering science lecture. In addition to a comprehensive introduction to Industry 4.0, the following topics will be addressed at the beginning of the lecture:

- Basics, history and temporal development of production
- Integrated production planning and integrated digital engineering
- Principles of integrated production systems and further development with Industry 4.0

Building on this, the phases of integrated production planning are taught in accordance with VDI Guideline 5200, whereby special features of parts production and assembly are dealt with in the context of case studies:

- Factory planning system
- Definition of objectives
- Data collection and analysis
- Concept planning (structural development, structural dimensioning and rough layout)
- Detailed planning (production planning and control, fine layout, IT systems in an industry 4.0 factory)
- Preparation and monitoring of implementation
- Start-up and series support

The lecture contents are rounded off by numerous current practical examples with a strong industry 4.0 reference. Within the exercises the lecture contents are deepened and applied to specific problems and tasks.

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

Literature
Lecture Notes

T 11.192 Course: Integrative Strategies in Production and Development of High Performance Cars [T-MACH-105188]

Responsible: Karl-Hubert Schlichtenmayer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2150601	Integrative Strategies in Production and Development of High Performance Cars	2 SWS	Lecture (V)	Schlichtenmayer
Exams					
SS 2019	76-T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars		Prüfung (PR)	Lanza

Competence Certificate
Written Exam (60 min)

Prerequisites
none

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

V Integrative Strategies in Production and Development of High Performance Cars — Lecture (V)
2150601, SS 2019, 2 SWS, Language: German, Open in study portal

Description
Media:

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

Notes

The lecture deals with the technical and organizational aspects of integrated development and production of sports cars on the example of Porsche AG. The lecture begins with an introduction and discussion of social trends. The deepening of standardized development processes in the automotive practice and current development strategies follow. The management of complex development projects is a first focus of the lecture. The complex interlinkage between development, production and purchasing are a second focus. Methods of analysis of technological core competencies complement the lecture. The course is strongly oriented towards the practice and is provided with many current examples.

The main topics are:

- Introduction to social trends towards high performance cars
- Automotive Production Processes
- Integrative R&D strategies and holistic capacity management
- Management of complex projects
- Interlinkage between R&D, production and purchasing
- The modern role of manufacturing from a R&D perspective
- Global R&D and production
- Methods to identify core competencies

Learning Outcomes:

The students ...

- are capable to specify the current technological and social challenges in automotive industry.
- are qualified to identify interlinkages between development processes and production systems.
- are able to explain challenges and solutions of global markets and global production of premium products.
- are able to explain modern methods to identify key competences of producing companies.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content

The lecture deals with the technical and organizational aspects of integrated development and production of sports cars on the example of Porsche AG. The lecture begins with an introduction and discussion of social trends. The deepening of standardized development processes in the automotive practice and current development strategies follow. The management of complex development projects is a first focus of the lecture. The complex interlinkage between development, production and purchasing are a second focus. Methods of analysis of technological core competencies complement the lecture. The course is strongly oriented towards the practice and is provided with many current examples.

The main topics are:

- Introduction to social trends towards high performance cars
- Automotive Production Processes
- Integrative R&D strategies and holistic capacity management
- Management of complex projects
- Interlinkage between R&D, production and purchasing
- The modern role of manufacturing from a R&D perspective
- Global R&D and production
- Methods to identify core competencies

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Lecture Slides

T 11.193 Course: Intellectual Property Rights and Strategies in Industrial Companies [T-MACH-105442]

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

Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102618 - Major Field: Production Technology
M-MACH-102633 - Major Field: Robotics
M-MACH-102636 - Major Field: Thermal Turbomachines
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2147160	Patents and Patentstrategies in innovative companies	2 SWS		Zacharias
WS 19/20	2147161	Intellectual Property Rights and Strategies in Industrial Companies	2 SWS	Lecture (V)	Zacharias

Competence Certificate
oral exam (20 min)

Prerequisites
none

Recommendation
None

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

V Patents and Patentstrategies in innovative companies
2147160, SS 2019, 2 SWS, Language: German, Open in study portal

Description
Media

- Beamer

Notes

Attendance at lectures (5 L): 24h

Personal preparation and follow-up of lecture and exercise: 5h

Preparation exam: 31h

The students understand and are able to describe the basics of intellectual property, particularly with regard to the filing and obtaining of property rights. They can name the criteria of project-integrated intellectual property management and strategic patenting in innovative companies. Students are also able to describe the key regulations of the law regarding employee invention and to illustrate the challenges of intellectual properties with reference to examples.

The lecture will describe the requirements to be fulfilled and how protection is obtained for patents, design rights and trademarks, with a particular focus on Germany, Europe and the EU. Active, project-integrated intellectual property management and the use of strategic patenting by technologically oriented companies will also be discussed. Furthermore, the significance of innovations and intellectual property for both business and industry will be demonstrated using practical examples, before going on to consider the international challenges posed by intellectual

property and current trends in the sector. Within the context of licensing and infringement, insight will be provided as to the relevance of communication, professional negotiations and dispute resolution procedures, such as mediation for example. The final item on the agenda will cover those aspects of corporate law that are relevant to intellectual property.

Lecture overview:

1. Introduction to intellectual property
2. The profession of the patent attorney
3. Filing and obtaining intellectual property rights
4. Patent literature as a source of knowledge and information
5. The law regarding employee inventions
6. Active, project-integrated intellectual property management
7. Strategic patenting
8. The significance of intellectual property
9. International challenges and trends
10. Professional negotiations and dispute resolution procedures
11. Aspects of corporate law

Learning Content

The lecture will describe the requirements to be fulfilled and how protection is obtained for patents, design rights and trademarks, with a particular focus on Germany, Europe and the EU. Active, project-integrated intellectual property management and the use of strategic patenting by technologically oriented companies will also be discussed. Furthermore, the significance of innovations and intellectual property for both business and industry will be demonstrated using practical examples, before going on to consider the international challenges posed by intellectual

property and current trends in the sector. Within the context of licensing and infringement, insight will be provided as to the relevance of communication, professional negotiations and dispute resolution procedures, such as mediation for example. The final item on the agenda will cover those aspects of corporate law that are relevant to intellectual property.

Lecture overview:

1. Introduction to intellectual property
2. The profession of the patent attorney
3. Filing and obtaining intellectual property rights
4. Patent literature as a source of knowledge and information
5. The law regarding employee inventions
6. Active, project-integrated intellectual property management
7. Strategic patenting
8. The significance of intellectual property
9. International challenges and trends
10. Professional negotiations and dispute resolution procedures
11. Aspects of corporate law

Workload

Attendance at lectures (5 L): 24h

Personal preparation and follow-up of lecture and exercise: 5h

Preparation exam: 31h

V **Intellectual Property Rights and Strategies in Industrial Companies** **Lecture (V)**

2147161, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content

The lecture will describe the requirements to be fulfilled and how protection is obtained for patents, design rights and trademarks, with a particular focus on Germany, Europe and the EU. Active, project-integrated intellectual property management and the use of strategic patenting by technologically oriented companies will also be discussed. Furthermore, the significance of innovations and intellectual property for both business and industry will be demonstrated using practical examples, before going on to consider the international challenges posed by intellectual property and current trends in the sector.

Within the context of licensing and infringement, insight will be provided as to the relevance of communication, professional negotiations and dispute resolution procedures, such as mediation for example. The final item on the agenda will cover those aspects of corporate law that are relevant to intellectual property.

Lecture overview:

1. Introduction to intellectual property
2. The profession of the patent attorney
3. Filing and obtaining intellectual property rights
4. Patent literature as a source of knowledge and information
5. The law regarding employee inventions
6. Active, project-integrated intellectual property management
7. Strategic patenting
8. The significance of intellectual property
9. International challenges and trends
10. Professional negotiations and dispute resolution procedures
11. Aspects of corporate law

Workload

regular attendance: 21 h

self-study: 99 h

T 11.194 Course: International Production Engineering A [T-MACH-110334]

Responsible: Prof. Dr.-Ing. Jürgen Fleischer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2150600	International Production Engineering A	SWS	Lecture (V)	Fleischer

Competence Certificate
Oral Exam (20 min)

Prerequisites
One of the following courses must be started:

- T-MACH-108844 - Automated Manufacturing Systems
- T-MACH-109055 - Machine Tools and Industrial Handling

Modeled Conditions
You have to fulfill one of 2 conditions:

1. The course T-MACH-108844 - Automated Manufacturing Systems must have been started.
2. The course T-MACH-109055 - Machine Tools and Industrial Handling must have been started.

Recommendation
This course can only be attended in combination with International Production Engineering B in the next winter semester.

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

V International Production Engineering A
2150600, SS 2019, SWS, Language: German/English, Open in study portal

Lecture (V)

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

Notes

The course “International Production Engineering” offers a practical insight into the development of production plants in an international environment. A student team works on a current and concrete problem in the field of production engineering, which is introduced into the project by an industrial partner who is operating as well in Germany as in China.

As part of the course "International Production Engineering A", the problem will initially be transferred into work packages. According to the elaborated project plan, ideas and concepts for a solution of the problem will be generated and developed. Based on the concepts, the validation is carried out using modern analytical and numerical methods. The results of the project will be presented and discussed to the project partner in a final meeting.

The practical implementation of the developed solution is part of the course "International Production Engineering B" during an eight-week research stay at the Advanced Manufacturing Technology Center (AMTC) in Shanghai. The project will be carried out by the students under the guidance of scientific staff and in cooperation with the industrial partner.

The project offers students ...

- the unique opportunity to put the contents of the accompanying lecture into practice in an interdisciplinary and creative context,
- to gain insights into a wide range of development activities relevant for their future careers,
- cooperation with an attractive industrial partner,
- work in a team with other students with competent support from scientific staff,
- first practical experience in project management,
- international practical experience.

Learning Outcomes:

The students ...

- can develop ideas for technical solutions in the environment of production plants in a team and evaluate their feasibility according to technical and economic criteria
- are capable of selecting the essential components and modules of a production plant and carrying out the necessary calculations
- can use FEM simulations to predict and evaluate the static and dynamic behavior of an assembly
- are able to present, plan and assess their own work and decision-making processes
- are able to apply basic methods of project management in an international environment.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content

The course “International Production Engineering” offers a practical insight into the development of production plants in an international environment. A student team works on a current and concrete problem in the field of production engineering, which is introduced into the project by an industrial partner who is operating as well in Germany as in China.

As part of the course "International Production Engineering A", the problem will initially be transferred into work packages. According to the elaborated project plan, ideas and concepts for a solution of the problem will be generated and developed. Based on the concepts, the validation is carried out using modern analytical and numerical methods. The results of the project will be presented and discussed to the project partner in a final meeting.

The practical implementation of the developed solution is part of the course "International Production Engineering B" during an eight-week research stay at the Advanced Manufacturing Technology Center (AMTC) in Shanghai. The project will be carried out by the students under the guidance of scientific staff and in cooperation with the industrial partner.

The project offers students ...

- the unique opportunity to put the contents of the accompanying lecture into practice in an interdisciplinary and creative context,
- to gain insights into a wide range of development activities relevant for their future careers,
- cooperation with an attractive industrial partner,
- work in a team with other students with competent support from scientific staff,
- first practical experience in project management,
- international practical experience.

Workload

Regular attendance: 21 hours
Self-study: 99 hours

T 11.195 Course: International Production Engineering B [T-MACH-110335]

Responsible: Prof. Dr.-Ing. Jürgen Fleischer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2149620	International Production Engineering B	SWS	Lecture (V)	Fleischer

Competence Certificate
Oral Exam (20 min)

Prerequisites
Successful completion of the following course:

- T-MACH-110334 - International Production Engineering A

Furthermore successful completion of one of the following courses:

- T-MACH-108844 - Automated Manufacturing Systems
- T-MACH-109055 - Machine Tools and Industrial Handling

Modeled Conditions
The following conditions have to be fulfilled:

1. You have to fulfill one of 2 conditions:
   1. The course T-MACH-108844 - Automated Manufacturing Systems must have been passed.
   2. The course T-MACH-109055 - Machine Tools and Industrial Handling must have been passed.
2. The course T-MACH-110334 - International Production Engineering A must have been passed.

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

V International Production Engineering B
2149620, WS 19/20, SWS, Language: German/English, Open in study portal

Lecture (V)

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

Notes

The course “International Production Engineering” offers a practical insight into the development of production plants in an international environment. A student team works on a current and concrete problem in the field of production engineering, which is introduced into the project by an industrial partner who is operating as well in Germany as in China.

As part of the course "International Production Engineering A", the problem will initially be transferred into work packages. According to the elaborated project plan, ideas and concepts for a solution of the problem will be generated and developed. Based on the concepts, the validation is carried out using modern analytical and numerical methods. The results of the project will be presented and discussed to the project partner in a final meeting.

The practical implementation of the developed solution is part of the course "International Production Engineering B" during an eight-week research stay at the Advanced Manufacturing Technology Center (AMTC) in Shanghai. The project will be carried out by the students under the guidance of scientific staff and in cooperation with the industrial partner.

The project offers students ...

- the unique opportunity to put the contents of the accompanying lecture into practice in an interdisciplinary and creative context
- to gain insights into a wide range of development activities relevant for their future careers
- cooperation with an attractive industrial partner
- work in a team with other students with competent support from scientific staff
- first practical experience in project management
- international practical experience.

Learning Outcomes:

The students ...

- can develop ideas for technical solutions in the environment of production plants in a team and evaluate their feasibility according to technical and economic criteria
- are capable of selecting the essential components and modules of a production plant and carrying out the necessary calculations
- can use FEM simulations to predict and evaluate the static and dynamic behavior of an assembly
- are able to present, plan and assess their own work and decision-making processes
- are able to apply basic methods of project management in an international environment.

Workload:

Regular attendance: 21 hours
Self-study: 99 hours

Learning Content

The course “International Production Engineering” offers a practical insight into the development of production plants in an international environment. A student team works on a current and concrete problem in the field of production engineering, which is introduced into the project by an industrial partner who is operating as well in Germany as in China.

As part of the course "International Production Engineering A", the problem will initially be transferred into work packages. According to the elaborated project plan, ideas and concepts for a solution of the problem will be generated and developed. Based on the concepts, the validation is carried out using modern analytical and numerical methods. The results of the project will be presented and discussed to the project partner in a final meeting.

The practical implementation of the developed solution is part of the course "International Production Engineering B" during an eight-week research stay at the Advanced Manufacturing Technology Center (AMTC) in Shanghai. The project will be carried out by the students under the guidance of scientific staff and in cooperation with the industrial partner.

The project offers students ...

- the unique opportunity to put the contents of the accompanying lecture into practice in an interdisciplinary and creative context
- to gain insights into a wide range of development activities relevant for their future careers
- cooperation with an attractive industrial partner
- work in a team with other students with competent support from scientific staff
- first practical experience in project management
- international practical experience.

Annotation

For organizational reasons, the number of participants in the course is limited. Hence, a selection process will take place. Applications can be made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php). The lecture can only be attended in combination with International Production Engineering A. Requirements for the lecture are a passed examination in "Machine Tools and Industrial Handling" or "Automated Production Systems" as well as a participation in the course "International Production Engineering A" in the previous summer semester.

Workload

Regular attendance: 21 hours
Self-study: 99 hours

T 11.196 Course: Introduction into Mechatronics [T-MACH-100535]

Responsible: Moritz Böhland
Dr.-Ing. Maik Lorch
PD Dr.-Ing. Markus Reischl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102633 - Major Field: Robotics
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	2

Events					
WS 19/20	2105011	Introduction into Mechatronics	3 SWS	Lecture (V)	Reischl, Lorch, Böhland
Exams					
SS 2019	76-T-MACH-100535	Introduction into Mechatronics		Prüfung (PR)	Reischl

Competence Certificate
Oral exam (Duration: 2h)

Prerequisites
none

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

V Introduction into Mechatronics
Lecture (V)

2105011, WS 19/20, 3 SWS, Language: German, Open in study portal

Notes
Content:

- Introduction
- Structure of mechatronic systems
- Mathematical treatment of mechatronic systems
- Sensors and actuators
- Measurements: acquisition and interpretation
- Modelling of mechatronic systems
- Control and feedback control systems
- Information processing

Learning objectives:

The student has knowledge about the specific challenge of interdisciplinary collaboration within the framework of mechatronics. He is able to explain the origin, necessity and methodic implementation of interdisciplinary collaboration, to name the main difficulties as well as the special features within the development of mechatronic products from the point of view of development methodic.

The student has fundamental knowledge of modeling mechanical, hydraulically and electrically part systems and about suitable optimization methods.

The student knows the difference in use of the term "system" in mechatronic and mechanical use.

Learning Content

- Introduction
- Structure of mechatronic systems
- Mathematical treatment of mechatronic systems
- Sensors and actuators
- Measurements: acquisition and interpretation
- Modelling of mechatronic systems
- Control and feedback control systems
- Information processing

Workload
regular attendance: 31.5 h

self-study: 148 h

Literature
Heimann, B.; Gerth, W.; Popp, K.: Mechatronik. Leipzig: Hanser, 1998
Isermann, R.: Mechatronische Systeme - Grundlagen. Berlin: Springer, 1999
Roddeck, W.: Einführung in die Mechatronik. Stuttgart: B. G. Teubner, 1997
Töpfer, H.; Kriesel, W.: Funktionseinheiten der Automatisierungstechnik. Berlin: Verlag Technik, 1988
Föllinger, O.: Regelungstechnik. Einführung in die Methoden und ihre Anwendung. Heidelberg: Hüthig, 1994
Bretthauer, G.: Modellierung dynamischer Systeme. Vorlesungsskript. Freiberg: TU Bergakademie, 1997

T 11.197 Course: Introduction into the Multi-Body Dynamics [T-MACH-105209]

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

Part of:
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	2

Events					
SS 2019	2162235	Introduction into the multi-body dynamics	3 SWS	Lecture (V)	Seemann
Exams					
SS 2019	76-T-MACH-105209	Introduction into the Multi-Body Dynamics		Prüfung (PR)	Seemann

Competence Certificate
Written examination, 180 min.

Prerequisites
none

Recommendation
Engineering Mechanics III/IV

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

V Introduction into the multi-body dynamics
2162235, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
The role of multibody systems in engineering, kinematics of a single rigid body, Kinematics of multibody systems, rotation matrix, angular velocity, derivatives in different reference systems, holonomic and non-holonomic constraints, Newton-Euler's equations, principle of d'Alembert, principle of virtuel power, Lagrange's equations, Kane's equations, structure of the equations of motion

Workload
time of attendance: 21,5h; self-study: 98h

Literature

Wittenburg, J.: Dynamics of Systems of Rigid Bodies, Teubner Verlag, 1977
Roberson, R. E., Schwertassek, R.: Dynamics of Multibody Systems, Springer-Verlag, 1988
de Jal'on, J. G., Bayo, E.: Kinematik and Dynamic Simulation of Multibody System.
Kane, T.: Dynamics of rigid bodies.

T 11.198 Course: Introduction to Ceramics [T-MACH-100287]

Responsible: Prof. Dr. Michael Hoffmann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	2125757	Introduction to Ceramics	3 SWS	Lecture (V)	Hoffmann
Exams					
SS 2019	76-T-MACH-100287	Introduction to Ceramics		Prüfung (PR)	Hoffmann, Schell, Wagner
WS 19/20	76-T-MACH-100287	Introduction to Ceramics		Prüfung (PR)	Hoffmann, Schell, Wagner

Competence Certificate
The assessment consists of an oral exam (30 min) taking place at a specific date.

The re-examination is offered at a specific date.

Prerequisites
None

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

V Introduction to Ceramics
Lecture (V)

2125757, WS 19/20, 3 SWS, Language: German, Open in study portal

Description
Media:

Slides for the lecture:

available under http://www.iam.kit.edu/km

Learning Content
After a short introduction to interatomic bonding, fundamental concepts of crystallography, the stereographic projection and the most important symmetry elements will be given. Different types of crystal structures are explained and the relevance of imperfections are analysed with respect to the mechanical and electrical properties of ceramics. Then, the impact of surfaces, interfaces and grain boundaries for the preparation, microstructural evolution and the resulting properties is discussed. Finally, an introduction is given to ternary phase diagrams.

The second part of the course covers structure, preparation and application aspects of nonmetallic inorganic glasses, followed by an introduction to the properties and processing methods of fine-grained technical powders. The most relevant shaping methods, such as pressing, slip casting, injection moulding and extrusion are introduced. Subsequently, the basics of science of sintering and the mechanisms for normal and abnormal grain growth are discussed. Mechanical properties of ceramics are analysed using basic principles of linear elastic fracture mechanics, Weibull statistics, concepts for subcritical crack growth and creep models to explain the behaviour at elevated temperatures. Furthermore it is demonstrated that mechanical properties can be siginificantly enhanced by various types of microstructural toughening mechanisms. The electronic and ionic conductivity of ceramic materials are explained based on defect-chemical considerations and band structure models. Finally, the characteristics of a dielectric, pyroelectric, and piezoelectric behaviour is discussed.

Workload
regular attendance: 45 hours
self-study: 135 hours

Literature

- H. Salmang, H. Scholze, "Keramik", Springer
- Kingery, Bowen, Uhlmann, "Introduction To Ceramics", Wiley
- Y.-M. Chiang, D. Birnie III and W.D. Kingery, "Physical Ceramics", Wiley
- S.J.L. Kang, "Sintering, Densification, Grain Growth & Microstructure", Elsevier

T 11.199 Course: Introduction to Industrial Production Economics [T-MACH-105388]

Responsible: Simone Dürrschnabel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Competence Certificate
oral exam (approx. 30 min)

The exam is offered in German only!

Prerequisites
none

T 11.200 Course: Introduction to Microsystem Technology - Practical Course [T-MACH-108312]

Responsible: Dr. Arndt Last
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	1

Events					
SS 2019	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course (P)	Last
WS 19/20	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course (P)	Last
Exams					
SS 2019	76-T-MACH-108312	Introduction to Microsystem Technology - Practical Course		Prüfung (PR)	Last

Competence Certificate
non-graded written examination

Prerequisites
none

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

V Introduction to Microsystem Technology - Practical Course

2143877, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy
Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Workload
Time of attendance: 21 h + 2 h exam
Privat studies: 5 h preparing experiments + 10 h preparing the exam

V Introduction to Microsystem Technology - Practical Course

2143877, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy
Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Workload
Time of attendance: 21 h + 2 h exam
Privat studies: 5 h preparing experiments + 10 h preparing the exam

T 11.201 Course: Introduction to Microsystem Technology I [T-MACH-105182]

Responsible: Dr. Vlad Badilita
Dr. Mazin Jouda
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102647 - Major Field: Microactuators and Microsensors
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2141861	Introduction to Microsystem Technology I	2 SWS	Lecture (V)	Korvink, Badilita
Exams					
SS 2019	76-T-MACH-105182	Introduction to Microsystem Technology I		Prüfung (PR)	Korvink, Badilita

Competence Certificate
written examination for implementation in a major field, 30 min oral exam for elective subject

Prerequisites
none

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

V Introduction to Microsystem Technology I

2141861, WS 19/20, 2 SWS, Language: English, Open in study portal **Lecture (V)**

Learning Content
- Introduction in Nano- and Microtechnologies
- Silicon and processes for fabricating microelectronics circuits
- Basic physics background and crystal structure
- Materials for micromachining
- Processing technologies for microfabrication
- Silicon micromachining
- Examples

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

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

T 11.202 Course: Introduction to Microsystem Technology II [T-MACH-105183]

Responsible: Dr. Mazin Jouda
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102647 - Major Field: Microactuators and Microsensors
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2142874	Introduction to Microsystem Technology II	2 SWS	Lecture (V)	Korvink, Badilita
Exams					
SS 2019	76-T-MACH-105183	Introduction to Microsystem Technology II		Prüfung (PR)	Korvink, Badilita

Competence Certificate
written examination for major field, oral exam (30 min) for elective field

Prerequisites
none

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

V Introduction to Microsystem Technology II — Lecture (V)
2142874, SS 2019, 2 SWS, Language: English, Open in study portal

Learning Content
- Introduction in Nano- and Microtechnologies
- Lithography
- LIGA-technique
- Mechanical microfabrication
- Patterning with lasers
- Assembly and packaging
- Microsystems

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

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

T 11.203 Course: Introduction to Neutron Cross Section Theory and Nuclear Data Generation [T-MACH-105466]

Responsible: Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190490	Introduction to Neutron Cross Section Theory and Nuclear Data Generation	2 SWS	Lecture (V)	Dagan
Exams					
SS 2019	76-T-MACH-105466	Introduction to Neutron Cross Section Theory and Nuclear Data Generation		Prüfung (PR)	Dagan, Stieglitz
WS 19/20	76-T-MACH-105466	Introduction to Neutron Cross Section Theory and Nuclear Data Generation		Prüfung (PR)	Dagan, Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Annotation
none

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

V Introduction to Neutron Cross Section Theory and Nuclear Data Generation

Lecture (V)

2190490, SS 2019, 2 SWS, Language: English, Open in study portal

Notes

Cross section characterization

Summary of basic cross section theory

Resonance cross section

Doppler broadening

Scattering kernels

Basic of slowing down theory

Unit cell based XS data generation

Cross sections Data libraries

Data Measurements

The students:

- Understand the special importance of cross sections in various domains of natural science (Reactor physics, Material research, Solar radiation etc.)
- Are familiar with the theoretical methods and experimental effort to generate cross sections data.

Regular attendance: 26 h

self study: 94 h

oral exam about 30 min.

Learning Content

Cross section characterization

Summary of basic cross section theory

Resonance cross section

Doppler broadening

Scattering kernels

Basic of slowing down theory

Unit cell based XS data generation

Cross sections Data libraries

Data Measurements

Workload

Regular attendance: 26 h

self study: 94 h

Literature

Handbook of Nuclear Reactors Calculations Vol. I Y. Ronen, CRC Press 1986

D. Emendorfer. K.H. Höcker Theory of nuclear reactions, Parts I, II BI- Hochschultaschenbücher 1969 (in German)

P. Tippler, R. Llewellyn Modern Physics 2008

T 11.204 Course: Introduction to Nonlinear Vibrations [T-MACH-105439]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Oral examination	7	Each winter term	1

Events					
WS 19/20	2162247	Introduction to Nonlinear Vibrations	2 SWS	Lecture (V)	Fidlin
WS 19/20	2162248	Introduction into the nonlinear vibrations (Tutorial)	2 SWS	Practice (Ü)	Fidlin, Schröders

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Vibration theory, Mathematical Methods of Vibration Theory, Dynamic Stability

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

V Introduction to Nonlinear Vibrations

2162247, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

- dynamic systems
- basic ideas of asymptotic methods
- perturbation methods: Linstedt-Poincare, averaging, multiple scales
- limit cycles
- nonlinear resonance
- basics of the bifurcation analysis, bifurcation diagrams
- types of bifurcations
- discontinuous systems
- dynamic chaos

Workload
time of attendance: 39 h
self-study: 201 h

Literature

- Hagedorn P. Nichtlineare Schwingungen. Akademische Verlagsgesellschaft, 1978.
- Nayfeh A.H., Mook D.T. Nonlinear Oscillation. Wiley, 1979.
- Thomsen J.J. Vibration and Stability, Order and Chaos. McGraw-Hill, 1997.
- Fidlin A. Nonlinear Oscillations in Mechanical Engigeering. Springer, 2005.
- Bogoliubov N.N., Mitropolskii Y.A. Asymptotic Methods in the Theory of Nonlinear Oscillations. Gordon and Breach, 1961.
- Nayfeh A.H. Perturbation Methods. Wiley, 1973.
- Sanders J.A., Verhulst F. Averaging methods in nonlinear dynamical systems. Springer-Verlag, 1985.
- Blekhman I.I. Vibrational Mechanics. World Scientific, 2000.
- Moon F.C. Chaotic Vibrations – an Introduction for applied Scientists and Engineers. John Wiley & Sons, 1987.

V **Introduction into the nonlinear vibrations (Tutorial)** **Practice (Ü)**
2162248, WS 19/20, 2 SWS, Language: German, Open in study portal

Workload
time of attendance: 10,5h; self-study: 20h

T 11.205 Course: Introduction to Nuclear Energy [T-MACH-105525]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189903	Introduction to Nuclear Energy	2 SWS	Lecture (V)	Cheng
Exams					
SS 2019	76-T-MACH-105525	Introduction to Nuclear Energy		Prüfung (PR)	Cheng

Competence Certificate
oral exam, 30 min

Prerequisites
none

T 11.206 Course: Introduction to Numerical Fluid Dynamics [T-MACH-105515]

Responsible: Dr. Balazs Pritz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

Events					
WS 19/20	2157444	Introduction to numerical fluid dynamics	2 SWS	Practical course (P)	Pritz

Competence Certificate
Certificate of participation

Prerequisites
none

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

V Introduction to numerical fluid dynamics
Practical course (P)

2157444, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
In the lab, the components of the cycle of computational fluid dynamics are worked through. In the first instance moderately complicated geometries will be generated and meshed. After the configuration and running the calculation, the results are presented and evaluated in a visualization software. While in the first part of the course these steps are worked out under guidance, calculation cycles are carried out independently in the second part. The test cases are discussed in detail and allow to strengthen the affinity to the fluid dynamics.

Content:

1. Brief introduction into Linux
2. Mesh generation with ICEMCFD
3. Data visualisation and interpretation with Tecplot
4. Handling of the flow solver SPARC
5. Self-designed calculation: flat plate
6. Introduction to unsteady calculations: flow around a circular cylinder

Annotation
In winter term 2012/2013:
Course: Computational Methods in Fluid Mechanics (Exercise) [2157442]

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

Literature
Lecture notes/handout

T 11.207 Course: Introduction to numerical mechanics [T-MACH-108718]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Exams				
SS 2019	76-T-MACH-108718	Introduction to numerical mechanics	Prüfung (PR)	

Competence Certificate
Oral Exam, 20 minutes

Prerequisites
None

Annotation
The lecture notes are made available via ILIAS.

T 11.208 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102628 - Major Field: Lightweight Construction

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	3

Events					
SS 2019	2162282	Introduction to the Finite Element Method	2 SWS	Lecture (V)	Langhoff, Böhlke
Exams					
SS 2019	76-T-MACH-105320	Introduction to the Finite Element Method		Prüfung (PR)	Böhlke, Langhoff

Competence Certificate
written exam (90 min)

Prerequisites
Passing the Tutorial "Introduction to the Finite element method" (T-MACH-110330) is a prerequisite for taking part in the exam.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110330 - Tutorial Introduction to the Finite Element Method must have been passed.

Annotation
Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected

The assignment of the restricted places in the associated Lab Course is crucial to the institute.

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

V Introduction to the Finite Element Method

Lecture (V)

2162282, SS 2019, 2 SWS, Language: German, Open in study portal

Notes

- introduction and motivation, elements of tensor calculus
- Discrete FEM: systems of bars and springs
- Formulations of boundary value problems (1D)
- Approximations in FEM
- FEM for scalar and vector-valued field problems
- Solution methods for linear systems of equations

T 11.209 Course: Introduction to Theory of Materials [T-MACH-105321]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2182732	Introduction to Theory of Materials	2 SWS	Lecture (V)	Kamlah
Exams					
SS 2019	76-T-MACH-105321	Introduction to Theory of Materials		Prüfung (PR)	Kamlah

Competence Certificate
oral exam

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

V Introduction to Theory of Materials

2182732, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Following a brief introduction into continuum mechanics at small deformations, the classification into elastic, viscoelastic, plastic and viscoplastic constitutive models of solids is discussed. Then, one after the other, the four groups of elastic, viscoelastic, plastic and viscoplastic constitutive models are motivated and mathematically formulated. Their properties are demonstrated by means of elementary analytical solutions and examples.

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

Literature
[1] Peter Haupt: Continuum Mechanics and Theory of Materials, Springer
[2] Lecture Notes

T 11.210 Course: IoT Platform for Engineering [T-MACH-106743]

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

Part of: M-MACH-102613 - Major Field: Lifecycle Engineering

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

Events					
SS 2019	2123352	IoT platform for engineering	3 SWS		Ovtcharova, Maier
WS 19/20	2123352	IoT platform for engineering	SWS		Ovtcharova, Maier

Competence Certificate
Assessment of another type (graded), procedure see webpage. Number of participants limited to 20 people. There is a participant selection process.

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

V IoT platform for engineering
2123352, SS 2019, 3 SWS, Open in study portal

Notes
Number of participants limited to 15 people. There is a participant selection process.

V IoT platform for engineering
2123352, WS 19/20, SWS, Language: German, Open in study portal

Learning Content
Industry 4.0, IT systems for fabrication and assembly, process modelling and execution, project work in teams, practice-relevant I4.0 problems, in automation, manufacturing industry and service.

T 11.211 Course: IT-Fundamentals of Logistics [T-MACH-105187]

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

Part of:
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102624 - Major Field: Information Technology
M-MACH-102625 - Major Field: Information Technology of Logistic Systems
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Oral examination	3	Each summer term	2

Events					
SS 2019	2118183	IT-Fundamentals of Logistics	2 SWS	Lecture (V)	Thomas
Exams					
SS 2019	76-T-MACH-105187	IT-Fundamentals of Logistics		Prüfung (PR)	Furmans, Mittwollen

Competence Certificate
The assessment consists of an oral exam (30min) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

Annotation
1) Detailed script can be downloaded online (www.tup.com), updated and enhanced annually.

2) CD-ROM with chapters and exercises at the end of the semester available from the lecturer, also updated and enhanced annually.

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

V IT-Fundamentals of Logistics

2118183, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

The rapid development of information technology influences business processes drastically.
A strategic IT-orientation for an enterprise without a critical appreciation of worldwide IT-development (where the half-life value of IT for logistic systems knowledge is less than 3 years) is dangerous. The pressure of costs is always in focus. For this purpose the contents of this course, as well as the detailed script will be continuously revised, and the influences on business processes will be shown in practical examples.

Focuses:

- **System architecture in Material Flow Control Systems (MFCS)**

A guiding principle for a new system architecture for MFC systems is the consideration of making new standardized, functional groups available for re-usability.

- **Design and application of innovative Material Flow Control Systems (MFCS)**

The most important task of the MFCS is the commissioning of conveying systems with driving commands in a way that optimally utilizes the facility and serves the logistics processes on schedule.

- **Identification of goods – Application in Logistics**

Along with business processes, coded information is the link between the flow of information and the flow of materials, and contributes to error prevention in the communication between people and machines.

- **Data communication in Intra-logistics**

Information describes the content of a message that is of value to the recipient.
The recipient can be both a human and a machine.

- **Business processes for Intra-logistics – Software follows function!**

If the business processes from Goods Incoming to Goods Outgoing are adapted with reusable building blocks then capabilities become visible. Against this background the consideration becomes apparent, how, through an innovative software architecture,
a reusable building-block based framework can be made.
Therefore applies: Software follows function. And only if all project requirements are documented in the planing phase, and supported together in an inter-disciplinary team - consisting of logistics planners, the customers (users) and the implementation leader (IL).

- **Software development in accordance with industrial standards**

Today's development of object-oriented software, and the increasing penetration of industrial software production with this technology, makes it possible to create system designs that already offer these opportunities in their facility - both for a high degree of reuse and for easier adaptability.
In software development, object-oriented methods are used to improve the productivity, maintainability and software quality. An important aspect of object-orientation is: the objects used are primarily intended to depict the real world.

Annotation

1) Detailed script can be downloaded online (www.tup.com), updated and enhanced annually.
2) CD-ROM with chapters and exercises at the end of the semester available from the lecturer, also updated and enhanced annually.

Workload

regular attendance: 21 hours
self-study: 99 hours

T 11.212 Course: Lab Computer-Aided Methods for Measurement and Control [T-MACH-105341]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102624 - Major Field: Information Technology
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

Events					
WS 19/20	2137306	Lab Computer-aided methods for measurement and control	3 SWS	Practical course (P)	Stiller, Richter

Competence Certificate
Colloquia

Prerequisites
none

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

V Lab Computer-aided methods for measurement and control

2137306, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Notes
Lerninhalt (EN):

1. Digital technology
2. Digital storage oscilloscope and digital spectrum analyzer
3. Supersonic computer tomography
4. Lighting and image acquisition
5. Digital image processing
6. Image interpretation
7. Control synthesis and simulation
8. Robot: Sensors
9 Robot: Actuating elements and path planning
The lab comprises 9 experiments.

Voraussetzungen: Recommendations:

Basic studies and preliminary examination; basic lectures in automatic control

Arbeitsaufwand (EN): 120 hours

Lernziele (EN):

Powerful and cheap computation resources have led to major changes in the domain of measurement
and control. Engineers in various fields are nowadays confronted with the application of computer-aided methods. This lab tries to give an insight into the modern domain of measurement and control by means of practically oriented and flexible experiments. Based on experiments
on measurement instrumentation and digital signal processing, elementary knowledge in the domain of visual inspection and image processing will be taught. Thereby, commonly used software like MATLAB/Simulink will be used in both simulation and realization of control loops. The lab closes with selected applications, like control of a robot or supersonic computer
tomography.

Learning Content
1. Digital technology
2. Digital storage oscilloscope and digital spectrum analyzer
3. Supersonic computer tomography
4. Lighting and image acquisition
5. Digital image processing
6. Image interpretation
7. Control synthesis and simulation
8. Robot: Sensors
9 Robot: Actuating elements and path planning
The lab comprises 9 experiments.

Workload
120 hours

Literature
Instructions to the experiments are available on the institute's website

T 11.213 Course: Lab Course Experimental Solid Mechanics [T-MACH-105343]

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

Part of: M-MACH-102591 - Laboratory Course

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2162275	Lab course experimental solid mechanics	3 SWS	Practical course (P)	N.N.
Exams					
SS 2019	76-T-MACH-105343	Lab Course Experimental Solid Mechanics		Prüfung (PR)	Böhlke

Competence Certificate
passed / not passed

Each participant has to hand in six lab course report (eon for each day of lab course), which will be evaluated. At the end of the lab course, the participants have to give a colloquium (approx 20 min) about a given topic of the experiments done.

Prerequisites
none

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

V Lab course experimental solid mechanics

2162275, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content

- Anisotropic materials
- Experiments for determination of the five material constants of thermoelasticity
- Experiments for determination of parameters of the inelatic material behaviour

Workload
regular attendance: 21,5 hours
self-study: 98,5 hours

Literature
is announced during lab course

T 11.214 Course: Laboratory Exercise in Energy Technology [T-MACH-105331]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Prof. Dr. Ulrich Maas
Heiner Wirbser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	1

Events					
SS 2019	2171487	Laboratory Exercise in Energy Technology	3 SWS	Practical course (P)	Bauer, Maas, Bykov
WS 19/20	2171487	Laboratory Exercise in Energy Technology	3 SWS	Practical course (P)	Bauer, Maas, Bykov
Exams					
SS 2019	76-T-MACH-105331	Laboratory Exercise in Energy Technology		Prüfung (PR)	Bauer, Maas, Wirbser

Competence Certificate
1 report, approx. 12 pages

Discussion of the documented results with the assistents

Prerequisites
none

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

V Laboratory Exercise in Energy Technology

2171487, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content

- Micro gas turbine
- Several test rigs for the investigation of heat transfer at thermally high loaded components
- Optimization of components of the internal air and oil system
- Characterization of spray nozzles
- Investigation of pollutant and noise emission as well as reliability and material deterioration
- Exhaust gas treatment
- Exhaust gas turbocharger
- Cooling Tower
- Heatpump
- Plant oil stove
- Heat capacity
- Wood combustion

Annotation
Online registration within the first two weeks of the lecture periode at: http://www.its.kit.edu

Workload
regular attendance: 42h
self-study: 78h

V **Laboratory Exercise in Energy Technology** **Practical course (P)**
2171487, WS 19/20, 3 SWS, Language: German, Open in study portal

Learning Content

- Micro gas turbine
- Several test rigs for the investigation of heat transfer at thermally high loaded components
- Optimization of components of the internal air and oil system
- Characterization of spray nozzles
- Investigation of pollutant and noise emission as well as reliability and material deterioration
- Exhaust gas treatment
- Exhaust gas turbocharger
- Cooling Tower
- Heatpump
- Plant oil stove
- Heat capacity
- Wood combustion

Annotation
Online registration within the first two weeks of the lecture periode at: http://www.its.kit.edu

Workload
regular attendance: 42h
self-study: 78h

T 11.215 Course: Laboratory Laser Materials Processing [T-MACH-102154]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	2

Events					
SS 2019	2183640	Laboratory "Laser Materials Processing"	3 SWS	Practical course (P)	Schneider, Pfleging
WS 19/20	2183640	Laboratory "Laser Materials Processing"	3 SWS	Practical course (P)	Schneider, Pfleging
Exams					
SS 2019	76-T-MACH-102154	Laboratory Laser Materials Processing		Prüfung (PR)	Schneider
WS 19/20	76-T-MACH-102154	Laboratory Laser Materials Processing		Prüfung (PR)	Schneider

Competence Certificate
The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Prerequisites
none

Recommendation
basic knowledge of physics, chemistry and material science

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

Annotation
The maximum number of students is 12 per semester.

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

V Laboratory "Laser Materials Processing"

Practical course (P)

2183640, SS 2019, 3 SWS, Language: German, Open in study portal

Description
Media:

lecture notes via ILIAS

Notes
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

• safety aspects

• surface hardening and remelting

• melt and reactive cutting

• surface modification by dispersing or alloying

• welding

• surface texturing

• metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student

- can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Learning Content
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

• safety aspects

• surface hardening and remelting

• melt and reactive cutting

• surface modification by dispersing or alloying

• welding

• surface texturing

• metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

Annotation
The maximum number of students is 12 per semester.

Workload
regular attendance: 34 hours
self-study: 86 hours

Literature
W.T. Silfvast: Laser Fundamentals, 2008, Cambrigde University Press

W.M. Steen: Laser Materials Processing, 2010, Springer

V **Laboratory "Laser Materials Processing"** **Practical course (P)**
2183640, WS 19/20, 3 SWS, Language: German, Open in study portal

Description
Media:

lecture notes via ILIAS

Notes
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

• safety aspects

• surface hardening and remelting

• melt and reactive cutting

• surface modification by dispersing or alloying

• welding

• surface texturing

• metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student

- can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Learning Content
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

• safety aspects

• surface hardening and remelting

• melt and reactive cutting

• surface modification by dispersing or alloying

• welding

• surface texturing

• metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

Annotation
The maximum number of students is 12 per semester.

Workload
regular attendance: 34 hours
self-study: 86 hours

Literature
W.T. Silfvast: Laser Fundamentals, 2008, Cambrigde University Press

W.M. Steen: Laser Materials Processing, 2010, Springer

T 11.216 Course: Laboratory Mechatronics [T-MACH-105370]

Responsible: Dr.-Ing. Maik Lorch
Prof. Dr.-Ing. Wolfgang Seemann
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102624 - Major Field: Information Technology
M-MACH-102633 - Major Field: Robotics
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	4

Events					
WS 19/20	2105014	Laboratory mechatronics	3 SWS	Practical course (P)	Seemann, Stiller, Lorch, Böhland, Burgert

Competence Certificate
certificate of successful attendance

Prerequisites
None

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

V Laboratory mechatronics

2105014, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Notes
Part I
Control, programming and simulation of robots
CAN-Bus communication
Image processing / machine vision
Dynamic simulation of robots in ADAMS

Part II
Solution of a complex problem in team work

Learning objectives:

The student is able to ...

- use his knowledge about mechatronics and microsystems technology to solve a practical problem. The laboratory course comprises simulation, bus communication, measurement instrumentation, control engineering and programming.
- integrate the different subsystems from a manipulator to a working compound system in teamwork.

Learning Content

Part I
Control, programming and simulation of robots
CAN-Bus communication
Image processing / machine vision
Dynamic simulation of robots in ADAMS

Part II
Solution of a complex problem in team work

Workload

regular attendance: 33.5 h

self-study: 88.5 h

Literature

Manuals for the laboratory course on Mechatronics

T 11.217 Course: Laboratory Production Metrology [T-MACH-108878]

Responsible: Dr.-Ing. Benjamin Häfner
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102591 - Laboratory Course
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102618 - Major Field: Production Technology
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102633 - Major Field: Robotics

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

Events					
SS 2019	2150550	Laboratory Production Metrology	3 SWS	Practical course (P)	Häfner
Exams					
SS 2019	76-T-MACH-108878	Laboratory Production Metrology		Prüfung (PR)	Häfner

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).

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

V Laboratory Production Metrology

2150550, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Description
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/). Additional reference to literature will be provided, as well.

Notes

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 student 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

Learning 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 student 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

Workload

regular attendance: 31,5 hours
self-study: 88,5 hours

T 11.218 Course: Laser in Automotive Engineering [T-MACH-105164]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102628 - Major Field: Lightweight Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2182642	Laser in automotive engineering	2 SWS	Lecture (V)	Schneider
Exams					
SS 2019	76-T-MACH-105164	Laser in Automotive Engineering		Prüfung (PR)	Schneider
WS 19/20	76-T-MACH-105164	Laser in Automotive Engineering		Prüfung (PR)	Schneider

Competence Certificate
oral examination (30 min)

no tools or reference materials

Prerequisites
It is not possible, to combine this brick with brick Physical Basics of Laser Technology [T-MACH-109084] and brick Physical Basics of Laser Technology [T-MACH-102102]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102102 - Physical Basics of Laser Technology must not have been started.
2. The course T-MACH-109084 - Physical Basics of Laser Technology must not have been started.

Recommendation
preliminary knowlegde in mathematics, physics and materials science

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

V Laser in automotive engineering

Lecture (V)

2182642, SS 2019, 2 SWS, Language: German, Open in study portal

Description
Media:

lecture notes via ILIAS

Notes
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in automotive engineering
- economical aspects
- savety aspects

The student

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of Nd:YAG-, CO2- and high power diode-laser sources.
- can describe the most important methods of laser-based processing in automotive engineering and illustrate the influence of laser, material and process parameters
- can analyse manufacturing problems and is able to choose a suitable laser source and process parameters.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

It is not possible, to combine this lecture with the lecture *Physical basics of laser technology* [2181612].

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

oral examination (ca. 30 min)

no tools or reference materials

Learning Content
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in automotive engineering
- economical aspects
- savety aspects

Annotation
It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

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

Literature
W. M. Steen: Laser Material Processing, 2010, Springer

W. T. Silfvast: Laser Fundamentals, 2008, Cambridge University Press

T 11.219 Course: Leadership and Conflict Management [T-MACH-105440]

Responsible: Hans Hatzl
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102596 - Compulsory Elective Subject Economics/Law
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102605 - Major Field: Engineering Design

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2110017	Leadership and Conflict Management (in German)	2 SWS	Lecture (V)	Hatzl
Exams					
SS 2019	76-T-MACH-105440	Leadership and Conflict Management		Prüfung (PR)	Deml

Competence Certificate
oral exam (approx. 30 min)

Prerequisites
none

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

V Leadership and Conflict Management (in German)
2110017, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

1. Introduction to the course
2. Goal definition and goal achievement
3. Management techniques within planning
4. Communication and information
5. Decision-making
6. Leadership and co-operation
7. Self management
8. Conflict management
9. Case studies

Requirements:

- Compact course
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

Recommendations:

- Knowledge of Work Science and Economics is helpful

Learning objective:

- Knowledge of techniques for management and leadership
- Preparation for management and leadership tasks in the job

Learning Content

1. Introduction to the course
2. Goal definition and goal achievement
3. Management techniques within planning
4. Communication and information
5. Decision-making
6. Leadership and co-operation
7. Self management
8. Conflict management
9. Case studies

Workload
The amount of work accounts for 120 h (=4 ECTS).

Literature
Handout and literature are available on ILIAS for download.

T 11.220 Course: Leadership and Management Development [T-MACH-105231]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102596 - Compulsory Elective Subject Economics/Law
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102618 - Major Field: Production Technology
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2145184	Leadership and Product Development	2 SWS	Lecture (V)	Ploch

Competence Certificate
oral exam (20 min)

Prerequisites
none

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

V Leadership and Product Development

2145184, WS 19/20, 2 SWS, Open in study portal

Lecture (V)

Learning Content
Leadership theories

Management tools

Communication as management tool

Change management

Management development and MD-Programs

Assessment center and management audits

Team work, team development und team roles

Intercultural competences

Leadership and ethics, Corporate Governance

Executive Coaching

Lectures of industrial experts

Workload
regular attendance: 21 h

self-study: 99 h

T 11.221 Course: Learning Factory “Global Production“ [T-MACH-105783]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Examination of another type	4	Each winter term	3

Events					
WS 19/20	2149612	Learning Factory “Global Production“	2 SWS		Lanza

Competence Certificate
Alternative test achievement (graded):

- Knowledge acquisition in the context of the seminar (3 achievements 20 min each) with weighting 40%.
- Interaction between participants with weighting 15%.
- Scientific colloquium (in groups of 3 students approx. 45 min each) with weighting 45%.

Prerequisites
none

Annotation
For organisational reasons, the number of participants for the course is limited to 20. As a result, a selection process will take place. Applications must be submitted via the wbk homepage (http://www.wbk.kit.edu/studium-und-lehre.php).

Due to the limited number of participants, advance registration is required.

Students should have previous knowledge in at least one of the following areas:

- Integrated Production Planning
- Global Production and Logistics
- Quality Management

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

V Learning Factory “Global Production“
2149612, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

E-learning platform ilias, powerpoint, photo protocol. The media are provided through ilias (https://ilias.studium.kit.edu/).

Notes

The learning factory “Global Production“ serves as a modern teaching environment for the challenges of global production. To make this challenges come alive, students can run a production of electric motors under real production conditions.
The course is divided into e-learning units and presence dates. The e-learning units help to learn essential basics and to immerse themselves in specific topics (e.g. selection of location, supplier selection and planning of production networks). The focus of the
presence appointments is the case-specific application of relevant methods for planning and control of production systems that are suitable for the location. In addition to traditional methods and tools to organize lean production systems (e.g. Kanban and JIT/ JIS,
Line Balancing) the lecture in particular deals with site-specific quality assurance and scalable automation. Essential methods for quality assurance in complex production systems are taught and brought to practical experience by a Six Sigma project. In the area of scalable automation, it is important to find solutions for the adaption of the level of automation of the production system to the local production conditions (e.g. automated workpiece transport, integration of lightweight robots for process linking) and to
implement them physically. At the same time safety concepts should be developed and implemented as enablers for human-robot collaboration.
The course also includes an excursion to the production plant for the manufacturing of electric motors of an industrial partner.

Main focus of the lecture:

- site selection
- site-specific factory planning
- site-specific quality assurance
- scalable automation
- supplier selection

Learning Outcomes:

The students are able to ...

- evaluate and select alternative locations using appropriate methods.
- use methods and tools of lean management to plan and manage production systems that are suitable for the location.
- use the Six Sigma method and apply goal-oriented process management.
- select an appropriate level of automation of the production units based on quantitative variables.
- make use of well-established methods for the evaluation and selection of suppliers.
- apply methods for planning a global production network depending on company-specific circumstances to sketch a suitable network and classify and evaluating it according to specific criteria.
- apply the learned methods and approaches with regard to problem solving in a global production environment and able to reflect their effectiveness.

Workload:

e-Learning: ~ 24 h
regular attendence: ~ 36 h
self-study: ~ 60 h

Learning Content
The learning factory “Global Production“ serves as a modern teaching environment for the challenges of global production. To make this challenges come alive, students can run a production of electric motors under real production conditions.
The course is divided into e-learning units and presence dates. The e-learning units help to learn essential basics and to immerse themselves in specific topics (e.g. selection of location, supplier selection and planning of production networks). The focus of the
presence appointments is the case-specific application of relevant methods for planning and control of production systems that are suitable for the location. In addition to traditional methods and tools to organize lean production systems (e.g. Kanban and JIT/ JIS,
Line Balancing) the lecture in particular deals with site-specific quality assurance and scalable automation. Essential methods for quality assurance in complex production systems are taught and brought to practical experience by a Six Sigma project. In the area of scalable automation, it is important to find solutions for the adaption of the level of automation of the production system to the local production conditions (e.g. automated workpiece transport, integration of lightweight robots for process linking) and to
implement them physically. At the same time safety concepts should be developed and implemented as enablers for human-robot collaboration.
The course also includes an excursion to the production plant for the manufacturing of electric motors of an industrial partner.

Main focus of the lecture:

- site selection
- site-specific factory planning
- site-specific quality assurance
- scalable automation
- supplier selection

Annotation
For organisational reasons, the number of participants for the course is limited to 20. As a result, a selection process will take place. Applications must be submitted via the wbk homepage (http://www.wbk.kit.edu/studium-und-lehre.php).

Due to the limited number of participants, advance registration is required.

Students should have previous knowledge in at least one of the following areas:

- Integrated Production Planning
- Global Production and Logistics
- Quality Management

Workload
e-Learning: ~ 24 h
regular attendence: ~ 36 h
self-study: ~ 60 h

11.222 Course: Lightweight Engineering Design [T-MACH-105221]

Responsible: Prof. Dr.-Ing. Albert Albers
Norbert Burkardt

Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102633 - Major Field: Robotics
M-MACH-102636 - Major Field: Thermal Turbomachines
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2146190	Lightweight Engineering Design	2 SWS	Lecture (V)	Albers, Burkardt
Exams					
SS 2019	76-T-MACH-105221	Lightweight Engineering Design		Prüfung (PR)	Albers, Burkardt

Competence Certificate
Written examination (90 min)

Prerequisites
None

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

V Lightweight Engineering Design
2146190, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
General aspects of leightweight design, lightweight strategies, construction methods, design principles, lightweight construction, stiffening techniques, lightweight materials, virtual product engineering, bionics, joining techniques, validation, recycling

Additionally, guest speakers from industry will present lightweight design from an practical point of view.

The students are able to ...

- evaluate the potential of central lightweight strategies and their application in design processes.
- apply different stiffing methods qualitatively and to evaluate their effectiveness.
- evaluate the potential of computer-aided engineering as well as the related limits and influences on manufacturing.
- reflect the basics of lightweight construction from a system view in the context of the product engineering process.

T 11.223 Course: Localization of Mobile Agents [T-INFO-101377]

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2019	24613	Localization of Mobile Agents	3 SWS	Lecture (V)	Noack, Li
Exams					
SS 2019	7500004	Localization of Mobile Agents		Prüfung (PR)	Hanebeck, Noack
WS 19/20	7500020	Localization of Mobile Agents		Prüfung (PR)	Noack, Hanebeck

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

V Localization of Mobile Agents

24613, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
This module provides a systematic introduction into the topic of localization methods. In order to facilitate understanding, the module is divided into four main topics. Dead reckoning treats the instantaneous determination of a vehicle's position based on dynamic parameters like velocity or steering angle. Localization with the help of measurements of known landmarks is part of static localization. In addition to the closed-form solutions for particular measurements (distances and angles), the least squares method for fusion arbitrary measurements is also introduced. Dynamic localization treats the combination of dead reckoning and static localization. The central part of the lecture is the derivation of the Kalman filter, which has been successfully applied in several practical applications. Finally, simultaneous localization and mapping (SLAM) is introduced, which allows localization in case of (partly) unknown landmark positions.

Workload
The amount of work required is ca.180 hours.

T 11.224 Course: Logistics - Organisation, Design and Control of Logistic Systems [T-MACH-102089]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102625 - Major Field: Information Technology of Logistic Systems

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2019	2118078	Logistics - Organisation, Design, and Control of Logistic Systems	3 SWS	Lecture (V)	Furmans
Exams					
SS 2019	76-T-MACH-102089	Logistics - Organisation, Design and Control of Logistic Systems		Prüfung (PR)	Furmans, Mittwollen

Competence Certificate
The assessment consists of a 90 minutes written examination (according to §4(2), 1 of the examination regulation).

Prerequisites
None

Recommendation
Requied are lectures on “Linear Algebra” and “Stochastic”.

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

V Logistics - Organisation, Design, and Control of Logistic Systems
Lecture (V)
2118078, SS 2019, 3 SWS, Language: German, Open in study portal

Description
Media:

Blackboard, LCD projector, in excercises also PCs.

Learning Content
Introduction

- historical overview
- lines of development

Structure of logistics systems
Distribution logistics

- location planning
- Vehicle Routing Planning
- distribution centers

Inventory management

- demand forecasting
- Inventory management policies
- Bullwhip effect

Production logistics

- layout planning
- material handling
- flow control

Supply Managament

- information flow
- transportation organization
- controlling and development of a logistics system
- co-operation mechanisms
- Lean SCM
- SCOR model

Identification Technologies

Workload
180 hrs

Literature

- Arnold/Isermann/Kuhn/Tempelmeier. Handbuch Logistik, Springer Verlag, 2002 (Neuauflage in Arbeit)
- Domschke. Logistik, Rundreisen und Touren, Oldenbourg Verlag, 1982
- Domschke/Drexl. Logistik, Standorte, Oldenbourg Verlag, 1996
- Gudehus. Logistik, Springer Verlag, 2007
- Neumann-Morlock. Operations-Research, Hanser-Verlag, 1993
- Tempelmeier. Bestandsmanagement in Supply Chains, Books on Demand 2006
- Schönsleben. Integrales Logistikmanagement, Springer, 1998

T 11.225 Course: Machine Dynamics [T-MACH-105210]

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

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102636 - Major Field: Thermal Turbomachines
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	1

Events					
SS 2019	2161224	Machine Dynamics	2 SWS	Lecture (V)	Proppe
SS 2019	2161225	Machine Dynamics (Tutorial)	1 SWS	Practice (Ü)	Proppe, Koebele
Exams					
SS 2019	76-T-MACH-105210	Machine Dynamics		Prüfung (PR)	Proppe

Competence Certificate
written exam, 180 min.

Prerequisites
none

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

V Machine Dynamics

2161224, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
1. Introduction

2. Machine as mechatronic system
3. Rigid rotors: equations of motion, transient and stationary motion, balancing
4. Flexible rotors: Laval rotor (equations of motion, transient and stationary behavior, critical speed, secondary effects), refined models)
5. Slider-crank mechanisms: kinematics, equations of motion, mass and power balancing

Workload
Lectures and exercices: 32 h

Studies: 118 h

Literature
Biezeno, Grammel: Technische Dynamik, 2. Edition, 1953

Holzweißig, Dresig: Lehrbuch der Maschinendynamik, 1979

Dresig, Vulfson: Dynamik der Mechanismen, 1989

V **Machine Dynamics (Tutorial)** **Practice (Ü)**
2161225, SS 2019, 1 SWS, Language: English, Open in study portal

Learning Content
Excercises related to the lecture

T 11.226 Course: Machine Dynamics II [T-MACH-105224]

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

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102636 - Major Field: Thermal Turbomachines
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2162220	Machine Dynamics II	2 SWS	Lecture (V)	Proppe

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Machine Dynamics

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

V Machine Dynamics II

Lecture (V)

2162220, WS 19/20, 2 SWS, Language: English, Open in study portal

Learning Content
- hydrodynamic bearings
- rotating shafts in hydrodynamic bearings
- belt drives
- virbation of turbine blades

Workload
Lectures: 20 h

Self-studies: 100 h

Literature
R. Gasch, R. Nordmann, H. Pfützner: Rotordynamik, Springer, 2006

T 11.227 Course: Machine Tools and Industrial Handling [T-MACH-109055]

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

Part of: M-MACH-102601 - Major Field: Automation Technology
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	8	Each winter term	1

Events					
WS 19/20	2149902	Machine Tools and Industrial Handling	6 SWS	Lecture / Practice (VÜ)	Fleischer
Exams					
SS 2019	76-T-MACH-109055	Machine Tools and Industrial Handling		Prüfung (PR)	Fleischer

Competence Certificate
Oral exam (40 minutes)

Prerequisites
"T-MACH-102158 - Werkzeugmaschinen und Handhabungstechnik" must not be commenced.

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

V Machine Tools and Industrial Handling

2149902, WS 19/20, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

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

Notes

The lecture gives an overview of the construction, use and application of machine tools and industrial handling equipment. In the course of the lecture a well-founded and practice-oriented knowledge for the selection, design and evaluation of machine tools is conveyed. First, the main components of the machine tools are systematically explained and their design principles as well as the integral machine tool design are discussed. Subsequently, the use and application of machine tools will be demonstrated using typical machine examples. Based on examples from current research and industrial applications, the latest developments are discussed, especially concerning the implementation of Industry 4.0.

The individual topics are:

- Frames and frame components
- Feed axes
- Spindles
- Peripheral equipment
- Control unit
- Metrological evaluation and machine testing
- Process monitoring
- Maintenance of machine tools
- Safety assessment of machine tools
- Machine examples

Learning Outcomes:

The students ...

- are able to assess the use and application of machine tools and handling equipment and to differentiate between them in terms of their characteristics and design.
- can describe and discuss the essential elements of the machine tool (frame, main spindle, feed axes, peripheral equipment, control unit).
- are able to select and dimension the essential components of a machine tool.
- are capable of selecting and evaluating machine tools according to technical and economic criteria.

Workload:

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

Learning Content

The lecture gives an overview of the construction, use and application of machine tools and industrial handling equipment. In the course of the lecture a well-founded and practice-oriented knowledge for the selection, design and evaluation of machine tools is conveyed. First, the main components of the machine tools are systematically explained and their design principles as well as the integral machine tool design are discussed. Subsequently, the use and application of machine tools will be demonstrated using typical machine examples. Based on examples from current research and industrial applications, the latest developments are discussed, especially concerning the implementation of Industry 4.0.

The individual topics are:

- Frames and frame components
- Feed axes
- Spindles
- Peripheral equipment
- Control unit
- Metrological evaluation and machine testing
- Process monitoring
- Maintenance of machine tools
- Safety assessment of machine tools
- Machine examples

Annotation

None

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

T 11.228 Course: Machine Vision [T-MACH-105223]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102624 - Major Field: Information Technology
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	8	Each winter term	2

Events					
WS 19/20	2137308	Machine Vision	4 SWS	Lecture / Practice (VÜ)	Lauer, Quehl
Exams					
SS 2019	76-T-MACH-105223	Machine Vision		Prüfung (PR)	Stiller, Lauer

Competence Certificate
Type of Examination: written exam

Duration of Examination: 60 minutes

Prerequisites
None

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

V Machine Vision

2137308, WS 19/20, 4 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)

Notes
Lernziele (EN):

Machine vision (or *computer vision*) describes all kind of techniques that can be used to extract information from camera images in an automated way. Considerable improvements of machine vision techniques throughout recent years, e.g. by the advent of deep learning, have caused growing interest in these techniques and enabled applications in various domains, e.g. robotics, autonomous driving, gaming, production control, visual inspection, medicine, surveillance systems, and augmented reality.

The participants should gain an overview over the basic techniques in machine vision and obtain hands-on experience.

Learning Content
The lecture on machine vision covers basic techniques of machine vision. It focuses on the following topics:

image preprocessing

edge and corner detection

curve and parameter fitting

color processing

image segmentation

camera optics

pattern recognition

deep learning

Image preprocessing:

The chapter on image processing discusses techniques and algorithms to filter and enhance the image quality. Starting from an analysis of the typical phenomena of digital camera based image capturing the lecture introduces the Fourier transform and the Shannon-Nyquist sampling theorem. Furthermore, it introduces gray level histogram based techniques including high dynamic range imaging. The disussion of image convolution and typical filters for image enhancement concludes the chapter.

Edge and corner detection:

Gray level edges and gray level corners play an important role in machine vision since gray level edges often reveal valueable information about the boundaries and shape of objects. Gray level corners can be used as feature points since they can be identified easily in other images. This chapter introduces filters and algorithms to reveal gray level edges and gray level corners like the Canny edge detector and the Harris corner detector.

Curve and parameter fitting:

In order to describe an image by means of geometric primitives (e.g. lines, circles, ellipses) instead of just pixels robust curve and parameter fitting algorithms are necessary. The lecture introduces and discusses the Hough transform, total least sum of squares parameter fitting as well as robust alternatives (M-estimators, least trimmed sum of squares, RANSAC)

Color processing:

The short chapter on color processing discusses the role of color information in machine vision and introduces various models for color understanding and color representation. It concludes with the topic of color consistency.

Image Segmentation:

Image segmentation belongs to the core techniques of machine vision. The goal of image segmentation is to subdivide the image into several areas. Each area shares common properties, i.e. similar color, similar hatching, or similar semantic interpretation. Various ideas for image segmentation exist which can be used to create more or less complex algorithms. The lecture introduces the most important approaches ranging from the simpler algorithms like region growing, connected components labeling, and morphological operations up to highly flexible and powerful methods like level set approaches and random fields.

Camera optics:

The content of an image is related by the optics of the camera to the 3-dimensional world. In this chapter the lecture introduces optical models that describe the relationship between the world and the image including the pinhole camera model, the thin lens model, telecentric cameras, and catadioptric sensors. Furthermore, the lecture introduces camera calibration methods that can be used to determine the optical mapping of a real camera.

Pattern recognition:

Pattern recognition aims at recognizing semantic information in an image, i.e. not just analyzing gray values or colors of pixels but revealing which kind of object is shown by the pixels. This task goes beyond classical measurement theory and enters the large field of artificial intelligence. Rather than just being developped and optimized by a programmer, the algorithms are adapting themselves to their specific task using training algorithms that are based on large collections of sample images.

The chapter of pattern recognition introduces standard techniques of pattern recognition in the context of image understanding like the support vector machine (SVM), decision trees, ensemble and boosting techniques. It combines those classifiers with powerful feature representation techniques like the histogram of oriented gradients (HOG) features, locally binary patterns (LBP), and Haar features.

Deep learning:

Throughout recent years standard pattern recognition technqiues have more and more been outperformed by deep learning techniques. Deep learning is based on artificial neural networks, a very generic and powerful form of a classifier. The lecture introduces multi layer perceptrons as the most relevant form of artificial neural networks, discusses training algorithms and strategies to achieve powerful classifiers based on deep learning including deep auto encoders, convolutional networks, and multi task learning, among others.

Workload
240 hours

Literature
Main results are summarized in the slides that are made available as pdf-files. Further recommendations will be presented in the lecture.

T 11.229 Course: Magnet Technology of Fusion Reactors [T-MACH-105434]

Responsible: Dr. Walter Fietz
Dr. Klaus-Peter Weiss

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190496	Magnet Technology of Fusion Reactors	2 SWS	Lecture (V)	Fietz, Weiss
Exams					
SS 2019	76-T-MACH-105434	Magnet Technology of Fusion Reactors		Prüfung (PR)	Fietz, Weiss, Stieglitz
WS 19/20	76-T-MACH-105434	Magnet Technology of Fusion Reactors		Prüfung (PR)	Cheng

Competence Certificate
Oral examination of about 30 minutes

Prerequisites
none

Annotation
none

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

V Magnet Technology of Fusion Reactors
2190496, SS 2019, 2 SWS, Language: German/English, Open in study portal

Lecture (V)

Notes

In Greifswald/Germany the fusion experiment Wendelstein 7-X is now in operation to demonstrate the performance of Stellerator-type fusion machines. In south of France the fusion reactor ITER is under construction which will demonstrate the production of energy by fusion. In both machines the plasma inclusion will be ensured by magnets and to produce high magnetic fields in an efficient way, these magnets have to be superconducting. Design, construction and operation of such magnets is a technologic challenge because low temperature (4.5 K) and high currents (typ. 68 kA) are necessary.

The lecture will show basic principles for design and construction of such magnets and includes:

- Introduction with examples to nuclear fusion and to magnetic plasma confinement
- Basics of low temperature and high temperature properties and cryotechnique
- Material testing and critical material properties at low temperatures
- Principles of magnet design, construction and safe magnet operation
- Present status and magnet examples from fusion projects ITER, W7-X and JT-60SA
- Application of high temperature superconductors on fusion and power engineering

The goal of the lecture is to impart the fundamentals of construction of superconducting magnets. Magnet technology is inherently of multidisciplinary character e.g. material properties at low temperature, high voltage and high current technique. The use of superconductors is mandatory to reach highest magnetic fields with comparable small losses. Examples of magnets from power application, basic research and fusion reactor construction are discussed.

Lecture Content:

- Basics of nuclear fusion and design aspects of fusion magnets
- Superconductors - basics and stability
- Low temperature cryogenic aspects
- Low temperature and high temperature superconductors
- Cryogenic material testing and properties of fusion materials at low temperatures
- Quench and high voltage aspects for magnets
- Status and magnets of fusion machines ITER, W7-X, JT-60SA & future DEMO
- Impact of high temperature superconductors on fusion and power engineering

Educational objective: The students know:

- Magnetic plasma confinement principles in connection with fusion machine
- Examples and basic properties of different superconductors
- Basics of formation of superconducting cables and magnet construction
- Generation of low temperature, cryostat construction
- Basics of magnet design and magnet safety
- Material testing and material properties at low temperatures
- High-temperature superconductor use in magnet construction and power application

Recommendations:

Knowledge in energy technology, power plants, material testing is welcomed

- Time of attendance: 2 SWS, Other: excursion, etc. 5 hours
- Self-study: preparation and postprocessing LV (course): 1 hour / week
- Preparation for the examination: 80 hours per semester

Oral examination of about 30 minutes

Learning Content

The goal of the lecture is to impart the fundamentals of construction of superconducting magnets. Magnet technology is inherently of multidisciplinary character e.g. material properties at low temperature, high voltage and high current technique. The use of superconductors is mandatory to reach highest magnetic fields with comparable small losses. Examples of magnets from power application, basic research and fusion reactor construction are discussed.

Lecture Content:

- Introduction to plasma, fusion and electromagnets
- Introduction superconductivity - basics and materials
- Creation of low temperatures, cryo-technique
- Material properties at low temperature
- Magnet design and calculation
- Magnet stability, quench safety and high voltage protection
- Magnet examples
- High-temperature superconductors (HTS)
- HTS-application (cable, motor/generator, FCL, current leads, fusion reactors)

Workload
- Time of attendance: 2 SWS, Other: excursion, etc. 5 hours
- Self-study: preparation and postprocessing LV (course): 1 hour / week
- Preparation for the examination: 80 hours per semester

T 11.230 Course: Magnetohydrodynamics [T-MACH-108845]

Responsible: Prof. Dr. Leo Bühler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

Type	Credits	Recurrence	Version
Completed coursework (oral)	6	Each winter term	1

Events					
WS 19/20	2153429	Magnetohydrodynamics	2 SWS	Lecture (V)	Bühler

Competence Certificate
The study performance is considered to have been passed if all exercise assignments have been successfully processed and the final colloquium (30 minutes) has been succesffully passed.

No auxiliary mean

Prerequisites
The partial performance number T-MACH-105426 "Magnetohydrodynamics" must not be startet or completed.

The partial services T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Etit) and T-MACH-105426 "Magnetohydrodynamics" are mutually exclusive.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105426 - Magnetohydrodynamics must not have been started.

Recommendation
Fluid Mechanics (T-MACH-105207)

Mathematical Methods in Fluid Mechanics (T-MACH-105295)

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

V Magnetohydrodynamics
2153429, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

- Introduction
- Basics of electro and fluid dynamics
- Exact solutions, Hartmann flow, pump, generator, channel flows
- Inductionless approximation
- Developing flows, change of cross-section, variable magnetic fields
- Alfven waves
- Stability, transition to turbulence
- Liquid dynamos

Educational objective: The students can describe the fundamentals of magnetohydrodynamics. They are qualified to explain the interrelations of electro and fluid dynamics so as to analyze magnetohydrodynamic flows in engineering applications or for phenomena in geo and astrophysics.

Learning Content

- Introduction
- Basics of electro and fluid dynamics
- Exact solutions, Hartmann flow, pump, generator, channel flows
- Inductionless approximation
- Developing flows, change of cross-section, variable magnetic fields
- Alfven waves
- Stability, transition to turbulence
- Liquid dynamos

Annotation
Recommendation: Fluid Mechanics

Workload
regular attendance: 21 hours

self-study: 90 hours

Literature
U. Müller, L. Bühler,2001,Magnetofluiddynamics in Channels and Containers, ISBN 3-540-41253-0, Springer

R. Moreau, 1990, Magnetohydrodynamics, Kluwer Academic Publisher

P. A. Davidson, 2001, An Introduction to Magnetohydrodynamics, Cambridge University Press

J. A. Shercliff, 1965, A Textbook of Magnetohydrodynamics, Pergamon Press

T 11.231 Course: Magnetohydrodynamics [T-MACH-105426]

Responsible: Prof. Dr. Leo Bühler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102634 - Major Field: Fluid Mechanic
M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153429	Magnetohydrodynamics	2 SWS	Lecture (V)	Bühler

Competence Certificate
oral

Duration: 30 minutes

No auxiliary means

Prerequisites
The partial performance number T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Etit) must not be startet or completed.

The partial services T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Etit) and T-MACH-105426 "Magnetohydrodynamics" are mutually exclusive.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108845 - Magnetohydrodynamics must not have been started.

Recommendation
Fluid Mechanics (T-MACH-105207)

Mathematical Methods in Fluid Mechanics (T-MACH-105295)

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

V Magnetohydrodynamics

Lecture (V)

2153429, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

- Introduction
- Basics of electro and fluid dynamics
- Exact solutions, Hartmann flow, pump, generator, channel flows
- Inductionless approximation
- Developing flows, change of cross-section, variable magnetic fields
- Alfven waves
- Stability, transition to turbulence
- Liquid dynamos

Educational objective: The students can describe the fundamentals of magnetohydrodynamics. They are qualified to explain the interrelations of electro and fluid dynamics so as to analyze magnetohydrodynamic flows in engineering applications or for phenomena in geo and astrophysics.

Learning Content

- Introduction
- Basics of electro and fluid dynamics
- Exact solutions, Hartmann flow, pump, generator, channel flows
- Inductionless approximation
- Developing flows, change of cross-section, variable magnetic fields
- Alfven waves
- Stability, transition to turbulence
- Liquid dynamos

Annotation
Recommendation: Fluid Mechanics

Workload
regular attendance: 21 hours

self-study: 90 hours

Literature
U. Müller, L. Bühler,2001,Magnetofluiddynamics in Channels and Containers, ISBN 3-540-41253-0, Springer

R. Moreau, 1990, Magnetohydrodynamics, Kluwer Academic Publisher

P. A. Davidson, 2001, An Introduction to Magnetohydrodynamics, Cambridge University Press

J. A. Shercliff, 1965, A Textbook of Magnetohydrodynamics, Pergamon Press

T 11.232 Course: Manufacturing Technology [T-MACH-102105]

Responsible: Prof. Dr.-Ing. Volker Schulze
Dr.-Ing. Frederik Zanger

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102605 - Major Field: Engineering Design
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Written examination	8	Each winter term	3

Events					
WS 19/20	2149657	Manufacturing Technology	6 SWS	Lecture / Practice (VÜ)	Schulze, Zanger
Exams					
SS 2019	76-T-MACH-102105	Manufacturing Technology		Prüfung (PR)	Schulze

Competence Certificate
Written Exam (180 min)

Prerequisites
none

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

V Manufacturing Technology

2149657, WS 19/20, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

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

Notes

The objective of the lecture is to look at manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to impart detailed process knowledge of the common processes. The lecture covers the basic principles of manufacturing technology and deals with the manufacturing processes according to their classification into main groups regarding technical and economic aspects. The lecture is completed with topics such as process chains in manufacturing.

The following topics will be covered:

- Quality control
- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming, plastics engineering)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment
- Process chains in manufacturing

This lucture provides an excursion to an industry company.

Learning Outcomes:

The students ...

- are capable to specify the different manufacturing processes and to explain their functions.
- are able to classify the manufacturing processes by their general structure and functionality according to the specific main groups.
- have the ability to perform a process selection based on their specific characteristics.
- are enabled to identify correlations between different processes and to select a process regarding possible applications.
- are qualified to evaluate different processes regarding specific applications based on technical and economic aspects.
- are experienced to classify manufacturing processes in a process chain and to evaluate their specific influence on surface integrity of workpieces regarding the entire process chain.

Workload:

regular attendance: 63 hours
self-study: 177 hours

Learning Content

The objective of the lecture is to look at manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to impart detailed process knowledge of the common processes. The lecture covers the basic principles of manufacturing technology and deals with the manufacturing processes according to their classification into main groups regarding technical and economic aspects. The lecture is completed with topics such as process chains in manufacturing.

The following topics will be covered:

- Quality control
- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming, plastics engineering)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment
- Process chains in manufacturing

This lucture provides an excursion to an industry company.

Annotation

None

Workload

regular attendance: 63 hours
self-study: 177 hours

Literature

Lecture Notes

T 11.233 Course: Master's Thesis [T-MACH-105299]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102858 - Master's Thesis

Type	Credits	Recurrence	Version
Final Thesis	30	Each term	1

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 master thesis is to be evaluated by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITG 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 74 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 earn at least 74 credits in the following fields:
    - Advanced Engineering Fundamentals
    - Specialization

T 11.234 Course: Material Flow in Logistic Systems [T-MACH-102151]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102629 - Major Field: Logistics and Material Flow Theory

Type	Credits	Recurrence	Version
Examination of another type	9	Each winter term	3

Events					
WS 19/20	2117051	Material flow in logistic systems	6 SWS	Others (sonst.)	Furmans
Exams					
SS 2019	76-T-MACH-102151	Material Flow in Logistic Systems		Prüfung (PR)	Furmans

Competence Certificate
The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
  - 40% assessment of the result of the case studies as group work,
  - 20% assessment of the oral examination during the case study colloquiums as individual performance.

A detailed description of the learning control can be found under Annotations.

Prerequisites
none

Recommendation
Recommended elective subject: Probability Theory and Statistics

Annotation
Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. In the oral examination during the case study colloquiums, the understanding of the result of the group work and the models dealt with in the course is tested. The participation in the oral defenses is compulsory and will be controlled. For the written submission the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

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

V Material flow in logistic systems

Others (sonst.)

2117051, WS 19/20, 6 SWS, Language: German, Open in study portal

Description
Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. During the colloquiums, the result of the case study is presented and the understanding of the group work and the models dealt with in the course are tested in an oral defense. The participation in the colloquiums is compulsory and will be controlled. For the written submission and the presentation the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

Media: Presentations, black board, book, video recordings

Notes

Learning Content:

- Elements of material flow systems (conveyor elements, fork, join elements)
- Models of material flow networks using graph theory and matrices
- Queueing theory, calculation of waiting time, utilization
- Warehouseing and order-picking
- Shuttle systems
- Sorting systems
- Simulation
- Calculation of availability and reliability
- Value stream analysis

After successful completion of the course, you are able (alone and in a team) to:

- Accurately describe a material handling system in a conversation with an expert.
- Model and parameterize the system load and the typical design elements of a material handling system.
- Design a material handling system for a task.
- Assess the performance of a material handling system in terms of the requirements.
- Change the main lever for influencing the performance.
- Expand the boundaries of today's methods and system components conceptually if necessary.

Literature:

Arnold, Dieter; Furmans, Kai: Materialfluss in Logistiksystemen; Springer-Verlag Berlin Heidelberg, 2009

Description:

Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. During the colloquiums, the result of the case study is presented and the understanding of the group work and the models dealt with in the course are tested in an oral defense. The participation in the colloquiums is compulsory and will be controlled. For the written submission and the presentation the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

We strongly recommend to attend the introductory session at 16.10.2019. In this session, the teaching concept of "Materialfluss in Logistiksysteme" is explained and outstanding issues are clarified.

Workload:

- Regular attendance: 35 h
- Self-study: 135 h
- Group work: 100 h

Competence Certificate:

The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
  - 40% assessment of the result and the presentation of the case studies as group work,
  - 20% assessment of the oral examination during the colloquiums as individual performance.

Learning Content

- Elements of material flow systems (conveyor elements, fork, join elements)
- Models of material flow networks using graph theory and matrices
- Queueing theory, calculation of waiting time, utilization
- Warehouseing and order-picking
- Shuttle systems
- Sorting systems
- Simulation
- Calculation of availability and reliability
- Value stream analysis

Annotation

none

Workload

Regular attendance: 35 h

Self-study: 135 h

Group work: 100 h

Literature

Arnold, Dieter; Furmans, Kai : Materialfluss in Logistiksystemen; Springer-Verlag Berlin Heidelberg, 2009

T 11.235 Course: Materials Characterization [T-MACH-107684]

Responsible: Dr.-Ing. Jens Gibmeier
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	3

Events					
WS 19/20	2174586	materials characterization	2 SWS	Lecture (V)	Schneider, Gibmeier
Exams					
SS 2019	76-T-MACH-107684	Materials Characterization		Prüfung (PR)	Heilmaier, Gibmeier
WS 19/20	76-T-MACH-107684	Materials Characterization		Prüfung (PR)	Heilmaier, Gibmeier

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
Successful participation in Exercises for Materials Characterization is the condition for the admittance to the oral exam in Materials Characterization.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107685 - Exercises for Materials Characterization must have been passed.

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

V materials characterization

2174586, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

learning objectives:
The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.
requirements:
none
workload:

The workload for the module "Materials Characterization" is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

Learning Content
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

Workload
The workload for the module “Materials Characterization” is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

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

Literature will be announced at the beginning of the lecture.

T 11.236 Course: Materials in Additive Manufacturing [T-MACH-110165]

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

Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2173600	Materials in Additive Manufacturing	2 SWS	Lecture (V)	Dietrich

Competence Certificate
oral exam, about 25 minutes

Prerequisites
none

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

V Materials in Additive Manufacturing

Lecture (V)

2173600, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
learning objectives:

requirements:
none

workload:

T 11.237 Course: Materials Modelling: Dislocation Based Plasticy [T-MACH-105369]

Responsible: Dr. Daniel Weygand
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102646 - Major Field: Applied Mechanics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2182740	Materials modelling: dislocation based plasticy	2 SWS	Lecture (V)	Weygand
Exams					
SS 2019	76-T-MACH-105369	Materials Modelling: Dislocation Based Plasticy		Prüfung (PR)	Weygand

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

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

V Materials modelling: dislocation based plasticy

2182740, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
1. Introduction
2. elastic fields of dislocations
3. slip, crystallography
4. equations of motion of dislocations
a) fcc
b) bcc
5. interaction between dislocations
6. molecular dynamics
7. discrete dislocation dynamics
8. continuum description of dislocations

The student

- has the basic understanding of the physical basics to describe dislocations and their interaction with point, line and area defects.
- can apply modelling approaches for dislocation based plasticity.
- can explain discrete methods for modelling of microstructural evolution processes.

preliminary knowlegde in mathematics, physics and materials science recommended

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

oral exam ca. 30 minutes

Learning Content
1. Introduction
2. elastic fields of dislocations
3. slip, crystallography
4. equations of motion of dislocations
a) fcc
b) bcc
5. interaction between dislocations
6. molecular dynamics
7. discrete dislocation dynamics
8. continuum description of dislocations

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

Literature

1. D. Hull and D.J. Bacon, Introduction to Dislocations, Oxford Pergamon 1994
2. W. Cai and W. Nix, Imperfections in Crystalline Solids, Cambridge University Press, 2016
3. J.P. Hirth and J. Lothe: Theory of dislocations, New York Wiley 1982. (oder 1968)
4. J. Friedel, Dislocations, Pergamon Oxford 1964.
5. V. Bulatov, W. Cai, Computer Simulations of Dislocations, Oxford University Press 2006
6. A.S. Argon, Strengthening mechanisms in crystal plasticity, Oxford materials.

T 11.238 Course: Materials of Lightweight Construction [T-MACH-105211]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102628 - Major Field: Lightweight Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2174574	Materials for Lightweight Construction	2 SWS	Lecture (V)	Liebig, Elsner
Exams					
SS 2019	76-T-MACH-105211	Materials of Lightweight Construction		Prüfung (PR)	Liebig, Weidenmann

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Recommendation
Materials Science I/II

Below you will find excerpts from events related to this course:

V Materials for Lightweight Construction

2174574, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

Introduction

Constructive, production-orientied and material aspects of lightweight construction

Aluminium-based alloys

Aluminium wrought alloys

Aluminium cast alloys

Magnesium-based alloys

Magnesium wrought alloys

Magnesium cast alloys

Titanium-based alloys

Titanium wrought alloys

Titanium cast alloys

High-strength steels

High-strength structural steels,

Heat-treatable steels, press-hardening and hardenable steels

Composites - mainly PMC

Matrices

Reinforcements

Basic mechanical principles of composites

Hybrid composites

Special materials for lightweight design

Beryllium alloys

Metallic Glasses

Applications

learning objectives:
The students are capable to name different lightweight materials and can describe their composition, properties and fields of application. They can describe the hardening mechanisms of lightweight materials and can transfer this knowledge to applied problems.
The students can apply basic mechanical models of composites and can depict differences in the mechanical properties depending on composition and structure. The students can describe the basic principle of hybrid material concepts and can judge their advantages in comparison to bulk materials. The students can name special materials for lightweight design and depict differences to conventional materials. The students have the ability to present applications for different lightweight materials and can balance reasons for their use.

requirements:
Werkstoffkunde I/II (recommended)

workload:

The workload for the lecture “Materials for Lightweight Construction” is 120 h per semester and consists of the presence during the lectures (24 h), preparation and rework time at home (48 h) and preparation time for the oral exam (48 h).

Learning Content

Introduction

Constructive, production-orientied and material aspects of lightweight construction

Aluminium-based alloys

Aluminium wrought alloys

Aluminium cast alloys

Magnesium-based alloys

Magnesium wrought alloys

Magnesium cast alloys

Titanium-based alloys

Titanium wrought alloys

Titanium cast alloys

High-strength steels

High-strength structural steels,

Heat-treatable steels, press-hardening and hardenable steels

Composites - mainly PMC

Matrices

Reinforcements

Basic mechanical principles of composites

Hybrid composites

Special materials for lightweight design

Beryllium alloys

Metallic Glasses

Applications

Workload

The workload for the lecture "Materials for Lightweight Construction" is 120 h per semester and consists of the presence during the lectures (24 h), preparation and rework time at home (48 h) and preparation time for the oral exam (48 h).

Literature

Presentation slides and additional lecture notes are handed out during the lecture, additional literature recommendations given

T 11.239 Course: Materials Science and Engineering III [T-MACH-105301]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Oral examination	8	Each winter term	1

Events					
WS 19/20	2173553	Materials Science and Engineering III	4 SWS	Lecture (V)	Heilmaier, Lang
WS 19/20	2173554	Übungen zu Werkstoffkunde III	1 SWS	Practice (Ü)	Heilmaier, Kauffmann
Exams					
SS 2019	76-T-MACH-105301	Materials Science III		Prüfung (PR)	Heilmaier, Lang

Competence Certificate
Oral exam, about 35 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Materials Science and Engineering III

2173553, WS 19/20, 4 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Properties of pure iron; thermodynamic foundations of single-component and of binary systems; nucleation and growth; diffusion processes in crystalline iron; the phase diagram Fe-Fe3C; effects of alloying on Fe-C-alloys; nonequilibrium microstructures; multicomponent iron-based alloys; heat treatment technology; hardenability and hardenability tests.

learning objectives:
The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid states (nucleation and growth phenomena), the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatmens and of alloying on the microstructure and the properties of iron-based materials (steels in particular). The can select steels for structural applications in mechanical engineering and subject them to appropriate heat treatmens.

requirements:
Basic knowledge in materials science and engineering (Werkstoffkunde I/II)

workload:

regular attendance: 53 hours
self-study: 187 hours

Learning Content
Properties of pure iron; thermodynamic foundations of single-component and of binary systems; nucleation and growth; diffusion processes in crystalline iron; the phase diagram Fe-Fe3C; effects of alloying on Fe-C-alloys; nonequilibrium microstructures; multicomponent iron-based alloys; heat treatment technology; hardenability and hardenability tests.

Workload
regular attendance: 53 hours
self-study: 187 hours

Literature
Lecture Notes; Problem Sheets; Bhadeshia, H.K.D.H. & Honeycombe, R.W.K.
Steels – Microstructure and Properties
CIMA Publishing, 3. Auflage, 2006

T 11.240 Course: Mathematical Fundamentals of Numerical Mechanics [T-MACH-108957]

Responsible: Prof. Dr. Eckart Schnack
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102614 - Major Field: Mechatronics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2162240	Mathematical Foundation for Computational Mechanics	2 SWS	Lecture (V)	Schnack
Exams					
SS 2019	76-T-MACH-108957	Mathematical Fundamentals of Numerical Mechanics		Prüfung (PR)	

Competence Certificate
Oral Examination Duration: 20 minutes

Prerequisites
None

Recommendation
none

Below you will find excerpts from events related to this course:

V Mathematical Foundation for Computational Mechanics — Lecture (V)
2162240, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Variational formulations. Functional analysis. Lagrange d process.Various function space definitions relating to the elasticity and dynamics of the mechanics. Measurements which enable the field calculation to be defined in applications.

Workload
Contact time: 22.5 hrs; Self-study: 97.5 hrs

T 11.241 Course: Mathematical Methods in Continuum Mechanics [T-MACH-110375]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102594 - Mathematical Methods
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Expansion	Version
Written examination	4	Each winter term	1 terms	1

Events					
WS 19/20	2161254	Mathematical Methods in Continuum Mechanics	2 SWS	Lecture (V)	Böhlke

Competence Certificate
written exam (90 min). Additives as announced.

Prerequisites
Passing the Tutorial to Mathematical Methods of Continuum Mechanics (T-MACH-110376)

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110376 - Tutorial Mathematical Methods in Continuum Mechanics must have been passed.

Below you will find excerpts from events related to this course:

V Mathematical Methods in Continuum Mechanics

Lecture (V)

2161254, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Tensor algebra

- vectors; basis transformation; dyadic product; tensors of 2nd order
- properties of 2nd order tensors: symmetry, anti-symmetry, orthogonality etc.
- eigenvalue problem, theorem of Cayley-Hamilton, invariants; tensors of higher order
- tensor algebra in curvilinear coordinate systems
- tensor analysis in curvilinear coordinate systems
- Differentiation of tensor functions

Application of tensor calculus in strength of materials

- kinematics of infinitesimal and finite deformations
- transport theorem, balance equations, stress tensor
- constitutive equations for solids and fluids
- Formulation of initial-boundary-value problems

Learning Content
Tensor algebra

- vectors; basis transformation; dyadic product; tensors of 2nd order
- properties of 2nd order tensors: symmetry, anti-symmetry, orthogonality etc.
- eigenvalue problem, theorem of Cayley-Hamilton, invariants; tensors of higher order
- tensor algebra in curvilinear coordinate systems
- tensor analysis in curvilinear coordinate systems
- Differentiation of tensor functions

Application of tensor calculus in strength of materials

- kinematics of infinitesimal and finite deformations
- transport theorem, balance equations, stress tensor
- constitutive equations for solids and fluids
- Formulation of initial-boundary-value problems

Workload
regular attendance: 31,5 hours
self-study: 88,5 hours

Literature
lecture notes
Bertram, A.: Elasticity and Plasticity of Large Deformations - an Introduction. Springer 2005.
Liu, I-S.: Continuum Mechanics. Springer, 2002.
Schade, H.: Tensoranalysis.Walter de Gruyter, New York, 1997.
Wriggers, P.: Nichtlineare Finite-Element-Methoden. Springer, 2001.

T 11.242 Course: Mathematical Methods in Dynamics [T-MACH-105293]

Responsible: Prof. Dr.-Ing. Carsten Proppe
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102594 - Mathematical Methods
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	2

Events					
WS 19/20	2161206	Mathematical Methods in Dynamics	2 SWS	Lecture (V)	Proppe
WS 19/20	2161207	Übungen zu Mathematische Methoden der Dynamik	1 SWS	Practice (Ü)	Oestringer, Proppe

Competence Certificate
written examination, 180 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Mathematical Methods in Dynamics

Lecture (V)

2161206, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
Dynamics of continua:
Concept of continuum, geometry of continua, kinematics and kinetics of continua

Dynamics of rigid bodies:
Kinematics and kinetics of rigid bodies

Variational principles:
Priniciple of virtual work, variational calculations, Principle of Hamilto

Approximate solution methods:
Methods of weighted residuals, method of Ritz

Applications

Workload
Lectures and exercices: 32 h

Studies: 148 h

Literature
Lecture notes (available online)

J.E. Marsden, T.J.R. Hughes: Mathematical foundations of elasticity, New York, Dover, 1994

P. Haupt: Continuum mechanics and theory of materials, Berlin, Heidelberg, 2000

M. Riemer: Technische Kontinuumsmechanik, Mannheim, 1993

K. Willner: Kontinuums- und Kontaktmechanik : synthetische und analytische Darstellung, Berlin, Heidelberg, 2003

J.N. Reddy: Energy Principles and Variational Methods in applied mechanics, New York, 2002

A. Boresi, K.P. Chong, S. Saigal: Approximate solution methods in engineering mechanics, New York, 2003

V **Übungen zu Mathematische Methoden der Dynamik** **Practice (Ü)**
2161207, WS 19/20, 1 SWS, Language: German, Open in study portal

Learning Content
Excercises related to the lecture

T 11.243 Course: Mathematical Methods in Fluid Mechanics [T-MACH-105295]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102594 - Mathematical Methods
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102634 - Major Field: Fluid Mechanic
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2019	2154432	Mathematical Methods in Fluid Mechanics	2 SWS	Lecture (V)	Frohnapfel, Stroh, Gatti
SS 2019	2154433	Tutorial in Mathematical Methods of Fluid Mechanics	1 SWS	Practice (Ü)	Frohnapfel, Stroh, Gatti
SS 2019	2154540	Mathematical Methods in Fluid Mechanics	SWS	Lecture (V)	Magagnato
Exams					
SS 2019	76-T-MACH-105295	Mathematical Methods in Fluid Mechanics		Prüfung (PR)	Frohnapfel, Gatti
WS 19/20	76-T-MACH-105295	Mathematical Methods in Fluid Mechanics		Prüfung (PR)	Frohnapfel

Competence Certificate
written examination - 3 hours

Prerequisites
none

Recommendation
Basic Knowledge about Fluid Mechanics

Below you will find excerpts from events related to this course:

V Mathematical Methods in Fluid Mechanics
Lecture (V)
2154432, SS 2019, 2 SWS, Language: German/English, Open in study portal

Description
Media:

chalk board, Power Point

Notes
The students can to simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

The lecture will cover a selection of the following topics:

- Potential flow theory
- Creeping flows
- Lubrication theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

The students can to simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

Learning Content
The lecture will cover a selection of the following topics:

- Potential flow theory
- Creeping flows
- Lubrication theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

Workload
regular attendance: 30 hours
self-study: 150 hours

Literature
Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Batchelor, G.K.: An Introduction to Fluid Dynamics, Cambridge Mathematical Library, 2000

Pope, S. B.: Turbulent Flows, Cambridge University Press, 2000

Ferziger, H., Peric, M.: Computational Methods for Fluid Dynamics, Springer, 2008

V **Tutorial in Mathematical Methods of Fluid Mechanics** **Practice (Ü)**
2154433, SS 2019, 1 SWS, Language: German, **Open in study portal**

Description
Media:

chalk board, Power Point

Notes
The exercises will practise the lecture topics:

- Curvilinear coordinates and tensor calculus
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

Learning Content
The exercises will practise the lecture topics:

- Curvilinear coordinates and tensor calculus
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature
Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Batchelor, G.K.: An Introduction to Fluid Dynamics, Cambridge

Mathematical Library, 2000

Boiko, A. V., Grek, G. R., Dovgal, A. V., Kozlov, V. V.: The Origin of Turbulence in Near-Wall Flows, Springer, 2002

Pope, S. B.: Turbulent Flows, Cambridge University Press, 2000

Ferziger, H., Peric, M.: Computational Methods for Fluid Dynamics, Springer, 2008

T 11.244 Course: Mathematical Methods in Micromechanics [T-MACH-110378]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102594 - Mathematical Methods
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Expansion	Version
Written examination	5	Each summer term	1 terms	1

Competence Certificate
written exam (180 min). Additives as announced.

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-106831 - Tutorial Mathematical Methods in Structural Mechanics must have been passed.

T 11.245 Course: Mathematical Methods in Strength of Materials [T-MACH-100297]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology

Type	Credits	Recurrence	Version
Written examination	5	Each winter term	4

Competence Certificate
written exam (90 min). Additives as announced.

Prerequisites
Passing the Tutorial to Mathematical Methods of Strength of Materials

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-106830 - Tutorial Mathematical Methods in Strength of Materials must have been passed.

T 11.246 Course: Mathematical Methods in Structural Mechanics [T-MACH-105298]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	2

Events					
SS 2019	2162204	Sprechstunde zu Mathematische Methoden der Strukturmechanik	2 SWS	Consultation-hour (Sprechst.)	N.N.
SS 2019	2162280	Mathematical Methods in Micromechanics	2 SWS	Lecture (V)	Böhlke
Exams					
SS 2019	76-T-MACH-105298	Mathematical Methods in Structural Mechanics		Prüfung (PR)	Böhlke, Langhoff

Competence Certificate
written exam (180 min). Additives as announced.

Prerequisites
Passing the tutorial to Mathematical Methods in Structural Mechanics T-MACH-106831

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-106831 - Tutorial Mathematical Methods in Structural Mechanics must have been passed.

Recommendation
This course is geared to MSc students. The contents of the lecture "Mathematical methods in Strength of Materials" are assumed to be known.

Below you will find excerpts from events related to this course:

V Mathematical Methods in Micromechanics

Lecture (V)

2162280, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
I Basics of variational calculus

- functionals; Frechet-differential; Gateaux-differential; maximum or minimum problems
- lemma of variational calculus and Lagrange delta-process; Euler-Lagrange-equations

II Applications: Principals of continuums mechanics

- variational principals in mechanics; variational formulierung of boundary value problem of elastostatic

III Applications: Homogenization methods for materials with microstructure

- mesoscopic and macroskopic stress and strain measures
- Mean values of ensembles, ergodicity
- effective elastic properties
- Homogenization of thermo-elastic properties
- Homogenization of plastic and visco-plastic properties
- Fe-based homogenization

Workload
regular attendance: 31,5 hours
self-study: 118,5 hours

T 11.247 Course: Mathematical Methods of Vibration Theory [T-MACH-105294]

Responsible: Prof. Dr.-Ing. Wolfgang Seemann
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102594 - Mathematical Methods
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	2

Events					
SS 2019	2162241	Mathematical methods of vibration theory	2 SWS	Lecture (V)	Seemann
SS 2019	2162242	Mathematical methods of vibration theory (Tutorial)	2 SWS	Practice (Ü)	Seemann, Burgert
Exams					
SS 2019	76-T-MACH-105294	Mathematical Methods of Vibration Theory		Prüfung (PR)	Seemann

Competence Certificate
written examination, 180 min.

Prerequisites
none

Recommendation
Engineering Mechanics III/IV

Below you will find excerpts from events related to this course:

V Mathematical methods of vibration theory

Lecture (V)

2162241, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Linear, time-invariant, ordinary single differential equations: homogeneous solution; harmonic, periodic and non-periodic excitations; Duhamel's integral; Fourier and Laplace transform; introduction into the theory of distributions; Systems of ordinary differential equations: matrix notation, eigenvalue theory, fundamental matrix, forced vibrations via modal expansion and transition matrix; Introduction into the dynamic stability theory; Partial differential equations: solution in product form, eigenvalue theory, modal expansion using Ritz series; Variational methods, Hamilton's principle, boundary value problems representing vibrating continua; Perturbation methods

Workload
time of attendance: 24h; self-study: 65h

Literature
Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

V **Mathematical methods of vibration theory (Tutorial)**
2162242, SS 2019, 2 SWS, Language: German, Open in study portal

Practice (Ü)

Learning Content
Seven tutorials with examples of the contents of the course

Workload
time of attendance: 10,5h; self-study: 20h

Literature
Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

T 11.248 Course: Mathematical Models and Methods for Production Systems [T-MACH-105189]

Responsible: Marion Baumann
Prof. Dr.-Ing. Kai Furmans

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102594 - Mathematical Methods
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102618 - Major Field: Production Technology
M-MACH-102633 - Major Field: Robotics
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	2117059	Mathematical models and methods for Production Systems	4 SWS	Lecture (V)	Baumann, Furmans

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Mathematical models and methods for Production Systems
2117059, WS 19/20, 4 SWS, Language: English, Open in study portal

Lecture (V)

Notes

Media:

black board, lecture notes, presentations

Learning Content:

- single server systems: M/M/1, M/G/1: priority rules, model of failures
- networks: open and closed approximations, exact solutions and approximations
- application to flexible manufacturing systems, AGV (automated guided vehicles) - systems
- modeling of control approaches like constant work in process (ConWIP) or kanban
- discrete-time modeling of queuing systems

Learning Goals:

Students are able to:

- Describe queueing systems with analytical solvable stochastic models,
- Derive approches for modeling and controlling material flow and production systems based on models of queueing theory,
- Use simulation and exakt methods.

Recommendations:

- Basic knowledge of statistic
- recommended compusory optional subject: Stochastics
- recommended lecture: Materials flow in logistic systems (also parallel)

Workload:

regular attendance: 42 hours
self-study: 198 hours

T 11.249 Course: Mathematical Models and Methods in Combustion Theory [T-MACH-105419]

Responsible: Dr. Viatcheslav Bykov
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102635 - Major Field: Engineering Thermodynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2165525	Mathematical models and methods in combustion theory	2 SWS	Lecture (V)	Bykov

Competence Certificate
oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Mathematical models and methods in combustion theory

Lecture (V)

2165525, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
The lecture shall introduce the basics of the mathematical modeling and the analysis of reacting flow systems. The fundamental models of combustion processes are outlined together with asymptotical methods, which deliver reasonable approximate solutions for numerous combustion processes. Many examples of simplified models for the description of auto-ignition, explosions, flame quenching and detonations will be presented and discussed. The main analytical methods will be illustrated using these simple examples.

Workload
Regular attendance: 22.5 h

Self-study: 97.5 h

Literature
Combustion Theory, F A Williams, (2nd Edition), 1985, Benjamin Cummins.

Combustion - Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, J. Warnatz, U. Mass and R. W. Dibble, (3nd Edition), Springer-Verlag, Heidelberg, 2003.

The Mathematical Theory of Combustion and Explosions, Ya.B. Zeldovich, G.I. Barenblatt, V.B. Librovich, G.M. Makhviladze, Springer, New York and London, 1985.

T 11.250 Course: Measurement [T-ETIT-101937]

Responsible: Prof. Dr.-Ing. Fernando Puente León
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Version
Written examination	5	2

Events					
WS 19/20	2302105	Measurement	2 SWS	Lecture (V)	Puente León
WS 19/20	2302107	Tutorial for 2302105 Measurement	1 SWS	Practice (Ü)	Puente León, Schambach
Exams					
SS 2019	7302105	Measurement Engineering		Prüfung (PR)	Puente León

T 11.251 Course: Measurement II [T-MACH-105335]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102624 - Major Field: Information Technology
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2138326	Measurement II	2 SWS	Lecture (V)	Stiller, Wirth
Exams					
SS 2019	76-T-MACH-105335	Measurement II		Prüfung (PR)	Stiller

Competence Certificate
written exam

60 min.

2 DIN A4 Self-created formular sheets allowed

Prerequisites
none

Below you will find excerpts from events related to this course:

V Measurement II
2138326, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Lerninhalt (EN)

1. Amplifiers
2. Digital technology
3. Stochastic modeling for measurement applications
4. Estimation
5. Kalman Filter
6. Environmental perception

Lernziele (EN):

The capabilities of modern sensor technology pave the way for novel applications in engineering. Especially digital measurement techniques may be used even in very complex environments and thus have strong impact on technological progress. Stochastic models of measurement processes form the basis for meaningful information processing and provide a valuable tool for engineering. This interdisciplinary lecture addresses students in mechanical engineering and related subjects. The lecture gives an overview of digital technology and stochastics. These areas form the basics of estimation methods that can be embedded elegantly in the theory of state observers. Applications in signal processing for modern environmental perception (video, Lidar, Radar) illustrate the discussed subjects.

Learning Content
1. Amplifiers
2. Digital technology
3. Stochastic modeling for measurement applications
4. Estimation
5. Kalman Filter
6. Environmental perception

Workload
120 hours

Literature
Various Scripts

T 11.252 Course: Measurement Instrumentation Lab [T-MACH-105300]

Responsible: Max Spindler
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2138328	Measurement Instrumentation Lab	2 SWS	Practical course (P)	Stiller, Richter

Competence Certificate
Non graded colloquia

Prerequisites
none

Below you will find excerpts from events related to this course:

V Measurement Instrumentation Lab

2138328, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Notes
Please consider the bulletin on our website!

A Signal recording

- measurement of temperature
- measurement of lengths

B Signal pre-precessing

- bridge circuits and principles of measurement
- analog/digital transducers

C Signal processing

- measuring stochastic signals

D Complete systems

- system identification
- inverse pendulum
- mobile robot platform

Recommendations:

Basic studies and preliminary examination; basic lectures in automatic control

Arbeitsaufwand: 90 hours

Lernziele (EN):

The laboratory complements the course "Introduction to Measurement and Control". While the course is organized into principles and subsystems, the laboratory presents complete measurement systems and methods for the most relevant industrial measurands.

Learning Content

A Signal recording

- measurement of temperature
- measurement of lengths

B Signal pre-precessing

- bridge circuits and principles of measurement
- analog/digital transducers

C Signal processing

- measuring stochastic signals

D Complete systems

- system identification
- inverse pendulum
- mobile robot platform

Workload

90 hours

T 11.253 Course: Mechanics and Strength of Polymers [T-MACH-105333]

Responsible: Prof. Dr.-Ing. Bernd-Steffen von Bernstorff
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102632 - Major Field: Polymer Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2173580	Mechanics and Strengths of Polymers	2 SWS	Lecture (V)	von Bernstorff

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Recommendation
Basic knowledge in materials science (e.g. lecture materials science I and II)

Below you will find excerpts from events related to this course:

V Mechanics and Strengths of Polymers

Lecture (V)

2173580, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Molecular structure and morphology of polymers, temperature- and time dependency of mechanical behavior, viscoelasticity, time/temperature- superposition principle, yielding, crazing and fracture of polymers, failure criterions, impact and dynamic loading, corresponding principle, tough/brittle-transition, introduction to the principles of fiber reinforcement and multiple cracking in composites

learning objectives:

The students are prepared to

- repeat the calculus on strength and design of engineering parts exposed to complex loadings,
- estimate the influence of time and temperature on the strength of polymeric materials,
- relate the strength of materials to their molecular structure, morphology and processing parameters and
- derive failure mechanisms for homogenuous polymers and composite materials therefrom.

requirements:
basic knowledge in materials science (e.g. lecture materials science I and II)

workload:

The workload for the lecture Mechanics and Strengths of Polymers is 120 h per semester and consists of the presence during the lecture (28 h) as well as preparation and rework time at home (92 h).

Learning Content
Molecular structure and morphology of polymers, temperature- and time dependency of mechanical behavior, viscoelasticity, time/temperature- superposition principle, yielding, crazing and fracture of polymers, failure criterions, impact and dynamic loading, corresponding principle, tough/brittle-transition, introduction to the principles of fiber reinforcement and multiple cracking in composites

Workload
The workload for the lecture Mechanics and Strengths of Polymers is 120 h per semester and consists of the presence during the lecture (28 h) as well as preparation and rework time at home (92 h).

Literature
A literature list, specific documents and partial lecture notes shall be handed out during the lecture.

T 11.254 Course: Mechanics in Microtechnology [T-MACH-105334]

Responsible: Dr. Christian Greiner
Dr. Patric Gruber

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2181710	Mechanics in Microtechnology	2 SWS	Lecture (V)	Gruber, Greiner
Exams					
SS 2019	76-T-MACH-105334	Mechanics in Microtechnology		Prüfung (PR)	Gruber

Competence Certificate
Oral examination, ca. 30 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Mechanics in Microtechnology
2181710, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
1. Introduction: Application and Processing of Microsystems
2. Scaling Effects
3. Fundamentals: Stress and Strain, (anisotropic) Hooke's Law
4. Fundamentals: Mechanics of Beams and Membranes
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and Mechnical Parameters such as Young'sModulus and YieldDtrength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Elektrostatics,...
8. Aktuation: Inverse Piezo-electric Effect, Shape Memory, Elektromagnetic Actuation,...

The students know and understand size and scaling effects in micro- and nanosystems. They understand the impact of mechanical phenomena in small dimensions. Based on this they can judge how they determine material processing as well as working principles and design of microsensors and microactuators.

regular attendance: 22,5 hours
self-study: 97,5 hours

oral exam ca. 30 minutes

Learning Content
1. Introduction: Application and Processing of Microsystems
2. Scaling Effects
3. Fundamentals: Stress and Strain, (anisotropic) Hooke's Law
4. Fundamentals: Mechanics of Beams and Membranes
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and Mechnical Parameters such as Young'sModulus and YieldDtrength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Elektrostatics,...
8. Aktuation: Inverse Piezo-electric Effect, Shape Memory, Elektromagnetic Actuation,...

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
Folien,
1. M. Ohring: "The Materials Science of Thin Films", Academic Press, 1992
2. L.B. Freund and S. Suresh: "Thin Film Materials"
3. M. Madou: Fundamentals of Microfabrication", CRC Press 1997
4. M. Elwenspoek and R. Wiegerink: "Mechanical Microsensors" Springer Verlag 2000
5. Chang Liu: Foundations of MEMS, Illinois ECE Series, 2006

T 11.255 Course: Mechanics of Laminated Composites [T-MACH-108717]

Responsible: Prof. Dr. Eckart Schnack
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102628 - Major Field: Lightweight Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2161983	Mechanics of laminated composites	2 SWS	Lecture (V)	Schnack
Exams					
SS 2019	76-T-MACH-108717	Mechanics of Laminated Composites		Prüfung (PR)	

Competence Certificate
Oral exam, approx. 20 minutes

Prerequisites
none

Annotation
The lecture notes are made available via ILIAS.

Below you will find excerpts from events related to this course:

V Mechanics of laminated composites
2161983, WS 19/20, 2 SWS, Open in study portal

Lecture (V)

Learning Content
Definition of composites, definition of static and kinematic groups. Definition of material laws. Transformation of the state values of composites and transformation of the material properties for the coordinate systems in the design of machine structures.

Workload
Contact time: 22.5 hrs; Self-study: 97.5 hrs

T 11.256 Course: Medical Imaging Techniques I [T-ETIT-101930]

Responsible: Prof. Dr. Olaf Dössel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Written examination	3	Each winter term	1

Events					
WS 19/20	2305261	Medical Imaging Techniques I	2 SWS	Lecture (V)	Dössel

Prerequisites
none

T 11.257 Course: Medical Imaging Techniques II [T-ETIT-101931]

Responsible: Prof. Dr. Olaf Dössel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	1

Events					
SS 2019	2305262	Medical Imaging Techniques II	2 SWS	Lecture (V)	Dössel
Exams					
SS 2019	7305262	Medical Imaging Techniques II		Prüfung (PR)	Dössel

T 11.258 Course: Medical Robotics [T-INFO-101357]

Responsible: Prof. Dr.-Ing. Torsten Kröger
Jun.-Prof. Dr. Franziska Mathis-Ullrich
Organisation: KIT Department of Informatics
Part of: M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	1

Events					
SS 2019	24681	Medical Robotics	2 SWS	Lecture (V)	Mathis-Ullrich
Exams					
SS 2019	7500129	Medical Robotics		Prüfung (PR)	Mathis-Ullrich

T 11.259 Course: Metal Forming [T-MACH-105177]

Responsible: Dr.-Ing. Thomas Herlan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2150681	Metal Forming	2 SWS	Lecture (V)	Herlan
Exams					
SS 2019	76-T-MACH-105177	Metal Forming		Prüfung (PR)	Schulze

Competence Certificate
Oral Exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Metal Forming

2150681, SS 2019, 2 SWS, Language: German, Open in study portal **Lecture (V)**

Description
Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

At the beginning of the lecture the basics of metal forming are briefly introduced. The focus of the lecture is on massive forming (forging, extrusion, rolling) and sheet forming (car body forming, deep drawing, stretch drawing). This includes the systematic treatment of the appropriate metal forming Machines and the corresponding tool technology. Aspects of tribology, as well as basics in material science and aspects of production planning are also discussed briefly. The plastic theory is presented to the extent necessary in order to present the numerical simulation method and the FEM computation of forming processes or tool design. The lecture will be completed
by product samples from the forming technology.

The topics are as follows:

- Introduction and basics
- Hot forming
- Metal forming machines
- Tools
- Metallographic fundamentals
- Plastic theory
- Tribology
- Sheet forming
- Extrusion
- Numerical simulation

Learning Outcomes:

The students ...

- are able to reflect the basics, forming processes, tools, Machines and equipment of metal forming in an integrated and systematic way.
- are capable to illustrate the differences between the forming processes, tools, machines and equipment with concrete examples and are qualified to analyze and assess them in terms of their suitability for the particular application.
- are also able to transfer and apply the acquired knowledge to other metal forming problems.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content

At the beginning of the lecture the basics of metal forming are briefly introduced. The focus of the lecture is on massive forming (forging, extrusion, rolling) and sheet forming (car body forming, deep drawing, stretch drawing). This includes the systematic treatment of the appropriate metal forming Machines and the corresponding tool technology. Aspects of tribology, as well as basics in material science and aspects of production planning are also discussed briefly. The plastic theory is presented to the extent necessary in order to present the numerical simulation method and the FEM computation of forming processes or tool design. The lecture will be completed
by product samples from the forming technology.
The topics are as follows:

- Introduction and basics
- Hot forming
- Metal forming machines
- Tools
- Metallographic fundamentals
- Plastic theory
- Tribology
- Sheet forming
- Extrusion
- Numerical simulation

Annotation

None

Workload

regular attendance: 21 hours
self-study: 99 hours

T 11.260 Course: Metallographic Lab Class [T-MACH-105447]

Responsible: Ulla Hauf
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	2

Events					
SS 2019	2175590	Metallographic Lab Class	3 SWS	Practical course (P)	Mühl
WS 19/20	2175590	Metallographic Lab Class	3 SWS	Practical course (P)	Mühl
Exams					
SS 2019	76-T-MACH-105447	Metallographic Lab Class		Prüfung (PR)	Heilmaier

Competence Certificate
Colloquium for every experiment, about 60 minutes, protocol

Prerequisites
none

Below you will find excerpts from events related to this course:

V Metallographic Lab Class
2175590, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Notes

learning objectives:

requirements:

workload:

V Metallographic Lab Class
2175590, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Notes

Light microscope in metallography

metallographic sections of metallic materials

Investigation of the microstructure of unalloyed steels and cast iron

Microstructure development of steels with accelerated cooling from the austenite area

Investigation of microstructures of alloyed steels

Investigation of failures quantitative microstructural analysis

Microstructural investigation of technically relevant non-ferrous metals

Application of Scanning electron microscope

learning objectives:

The students in this lab class gain are able to perform standard metallographic preparations and are able to apply standard software for quantitative microstructural analyses. Based on this the student can interpret unetched as well as etched microstructures with respect to relevant microstructural features. They can draw concluding correlations between heat treatments, ensuing microstructures and the resulting mechanical as well as physical properties of the investigated materials.

requirements:

Material Science I/II

workload:

The workload for the Metallographic Lab Class is 120 h per semester and consists of the presence during the lab course (25 h) as well as preparation and rework time at home (95 h).

Learning Content

Light microscope in metallography

metallographic sections of metallic materials

Investigation of the microstructure of unalloyed steels and cast iron

Microstructure development of steels with accelerated cooling from the austenite area

Investigation of microstructures of alloyed steels

Investigation of failures quantitative microstructural analysis

Microstructural investigation of technically relevant non-ferrous metals

Application of Scanning electron microscope

Workload

The workload for the Metallographic Lab Class is 120 h per semester and consists of the presence during the lab course (25 h) as well as preparation and rework time at home (95 h).

Literature

E. Macherauch: Praktikum in Werkstoffkunde, 10th edition, 1992

H. Schumann: Metallographie, 13th edition, Deutscher Verlag für Grundstoffindustrie, 1991

Literature List will be handed out with each experiment

T 11.261 Course: Metals [T-MACH-105468]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr. Astrid Pundt

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2019	2174598	Metals	3 SWS	Lecture (V)	Pundt, Heilmaier, Kauffmann
SS 2019	2174599	Übungen zur Vorlesung "Metalle"	1 SWS	Practice (Ü)	Heilmaier, Pundt, Kauffmann
Exams					
SS 2019	76-T-MACH-105468	Metals		Prüfung (PR)	Heilmaier
WS 19/20	76-T-MACH-105468	Metals		Prüfung (PR)	Heilmaier, Pundt

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Metals
2174598, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

learning objectives:
The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanicla and physical properties of metallic materials. This competence is in particular deepened for iron- and aluminum-based alloys.
requirements:
Materials physics
workload:

Regular attendance: 42 h

Self-study: 138 h

Learning Content
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

Workload
Regular attendance: 42 h

Self-study: 138 h

Literature
D.A. Porter, K. Easterling, Phase Transformation in Metals and Alloys, 2nd edition, Chapman & Hall, London 1997,

J. Freudenberger: http://www.ifw-dresden.de/institutes/imw/lectures/lectures/pwe

V Übungen zur Vorlesung "Metalle"

2174599, SS 2019, 1 SWS, Language: German, Open in study portal

Practice (Ü)

Notes
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

learning objectives:
The Students have hands-on experience in the application of thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanicla and physical properties of metallic materials. This competence is in particular practiced for iron- and aluminum-based alloys.
requirements:
Materials physics
workload:

Regular attendance: 14 h

Self-study: 16 h

Learning Content
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

Workload
Regular attendance: 14 h

Self-study: 16 h

Literature
G. Gottstein: „Materialwissenschaft und Werkstofftechnik: Physikalische Grundlagen“, Springer (2014)
http://dx.doi.org/10.1007/978-3-642-36603-1 (frei über die KIT-Lizenz abrufbar)
J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
http://www.ifw-dresden.de/institutes/imw/lectures/pwe
P. Haasen: „Physikalische Metallkunde“, Cambridge University Press (2003)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC309606810
R.W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland (1996)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656
D. A. Porter, K. Easterling: „Phase Transformation in Metals and Alloys“, Chapman & Hall (2009)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X
E. Hornbogen, H. Warlimont: „Metalle: Struktur und Eigenschaften von Metallen und Legierungen“, Springer (2016)
http://dx.doi.org/10.1007/978-3-662-47952-0 (frei über die KIT-Lizenz abrufbar)
E. Hornbogen, G. Eggeler, E. Werner: „Werkstoffe: Aufbau und Eigenschaften von Keramik-, Metall-, Polymer- und Verbundwerkstoffen“, Springer (2012)
http://dx.doi.org/10.1007/978-3-642-22561-1 (frei über die KIT-Lizenz abrufbar)
H.-J. Bargel, G. Schulze: „Werkstoffkunde“, Springer (2012)
http://dx.doi.org/10.1007/978-3-642-17717-0 (frei über die KIT-Lizenz abrufbar)
J. Rösler, H. Harders, M. Bäker: „Mechanisches Verhalten der Werkstoffe“, Springer Vieweg (2016)
http://dx.doi.org/10.1007/978-3-658-13795-3 (frei über die KIT-Lizenz abrufbar)

11.262 Course: Methods and Processes of PGE - Product Generation Development [T-MACH-109192]

Responsible: Prof. Dr.-Ing. Albert Albers
Norbert Burkardt
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102718 - Product Development - Methods of Product Development

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2019	2146176	Methods and processes of PGE - Product Generation Development	3 SWS	Lecture (V)	Albers
Exams					
SS 2019	76-T-MACH-105382	Product Development - Methods of Product Development		Prüfung (PR)	Albers
SS 2019	76-T-MACH-105382-en	Methods and Processes of PGE - Product Generation Engineering		Prüfung (PR)	Albers

Competence Certificate
Written exam (processing time: 120 min + 10 min reading time)

Auxiliaries:

- Calculator
- German dictionary (books only)

Prerequisites
None

Annotation
This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

Below you will find excerpts from events related to this course:

V Methods and processes of PGE - Product Generation Development

Lecture (V)

2146176, SS 2019, 3 SWS, Language: German, Open in study portal

Notes

Note:

This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

Recommendations:

none

Workload:

regular attendance: 31.5 h

self-study: 148.5 h

Examination:

Written exam

Duration: 120 minutes (+10 minutes reading time)

Auxiliaries:

- Calculator
- German dictionary (books only)

Course content:

Basics of Product Development: Basic Terms, Classification of the Product
Development into the industrial environment, generation of costs / responsibility for costs
Concept Development: List of demands / Abstraction of the Problem Definition / Creativity Techniques / Evaluation and selection of solutions
Drafting : Prevailing basic rules of Design / Design Principles as a
problem oriented accessory
Rationalization within the Product Development: Basics of Development
Management/ Simultaneous Engineering and Integrated Product Development/Development of Product
Lines and Modular Construction Systems
Quality Assurance in early Development Phases : Methods of Quality Assurance
in an overview/QFD/FMEA

Learning objectives:

The students are able to ...

- classify product development in companies and differentiate between different types of product development.
- name the relevant influencing factors of a market for product development.
- name, compare and use the central methods and process models of product development within moderate complex technical systems.
- explain problem solving techniques and associated development methods.
- explain product profiles and to differentiate and choose suitable creative techniques of solution/idea generation finding on this basis.
- use design guidelines to create simple technical systems and to explain these guidelines.
- name and compare quality assurance methods; to choose and use suitable methods for particular applications.
- explain the differents methods of design of experiment.
- explain the costs in development process.

T 11.263 Course: Methods of Signal Processing [T-ETIT-100694]

Responsible: Prof. Dr.-Ing. Fernando Puente León
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	1

Events					
WS 19/20	2302113	Methods of Signal Processing	2 SWS	Lecture (V)	Puente León
WS 19/20	2302115	Methods of Signal Processing (Tutorial to 2302113)	1+1 SWS	Practice (Ü)	Puente León, Krippner
Exams					
SS 2019	7302113	Methods of Signal Processing		Prüfung (PR)	Puente León

Prerequisites
none

T 11.264 Course: Micro- and nanosystem integration for medical, fluidic and optical applications [T-MACH-108809]

Responsible: Dr. Ulrich Gengenbach
Prof. Dr. Veit Hagenmeyer
Dr. Liane Koker
PD Dr.-Ing. Ingo Sieber

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2105032	Micro- and nanosystem integration for medical, fluidic and optical applications	2 SWS	Lecture (V)	Koker, Gengenbach, Sieber
Exams					
SS 2019	76-T-MACH-108809	Micro- and nanosystem integration for medical, fluidic and optical applications		Prüfung (PR)	Koker, Gengenbach, Sieber

Competence Certificate
Oral exam (Duration: 30min)

Prerequisites
T-MACH-105695 "Selected topics of system integration for micro- and nanotechnology" must not be started.

Below you will find excerpts from events related to this course:

V Micro- and nanosystem integration for medical, fluidic and optical applications
Lecture (V)
2105032, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

Content:

- Introduction to the role of system integration in the product development process
- Simplistic modeling and use of analogies in system design
- Introduction to modeling and simulation in system design
- Mechanics simulation
- Optics simulation
- Fluidics simulation
- Coupling of simulation tools
- Requirements for system integration of active implants
- Design of active implants
- Approaches to system integration of active implants
- Test methods (hermeticity, accelerated aging etc.)
- Micro-optical subsystems
- Micro-fluidic subsystems
- Self-assembly as integration process at micro and nano scale

Learning objectives:

The students ...:

- have a fundamental understanding of modeling using analogies
- know the basics of modeling and simulation in design of mechanical, optical, and fluidic subsystems
- can assess the need for inter-domain simulations
- understand the challenges in the design of active implants
- have an overview of different active implants and their applications
- know approaches to system integration and packaging of active implants
- are familiar with different methods of testing with the focus on hermeticity
- have an overview of processes for the integration of micro-optical and micro-fluidic subsystems
- gain insight into technical applications of self-assembly processes

Learning Content

- Introduction to the role of system integration in the product development process
- Simplistic modeling and use of analogies in system design
- Introduction to modeling and simulation in system design
- Mechanics simulation
- Optics simulation
- Fluidics simulation
- Coupling of simulation tools
- Requirements for system integration of active implants
- Design of active implants
- Approaches to system integration of active implants
- Test methods (hermeticity, accelerated aging etc.)
- Micro-optical subsystems
- Micro-fluidic subsystems
- Self-assembly as integration process at micro and nano scale

Workload

regular attendance: 21 hours
self-study: 99 hours

T 11.265 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-102616 - Major Field: Microsystem Technology
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

Events					
WS 19/20	2141501	Micro Magnetic Resonance	2 SWS	Seminar (S)	MacKinnon, Badilita, Jouda, Korvink

Competence Certificate
Own Presentation, participation at the course discussions, result is passed or failed.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Micro Magnetic Resonance

2141501, WS 19/20, 2 SWS, Language: English, Open in study portal

Seminar (S)

Learning Content
Nuclear magnetic resonance (NMR), or magnetic resonance in general (MR) is a powerful, non-invasive technique useful for gaining atomic level structural details on samples ranging from soluble small molecules to large membrane bound proteins. Traditional NMR hardware used for exciting the sample and detecting the signal is traditionally on the macroscale in terms of physical dimensions. Recently, miniaturization of NMR systems has developed into an active research area driven primarily by the enhanced mass sensitivity and the ability for system integration with smaller NMR detectors. In this seminar course, we will explore some of the state-of-the-art applications of micro-NMR, including visiting research laboratories within Germany active in micro-MR. A selection of representative research papers will be provided, from which each student will select one paper to learn in depth and finally present in a style as if they performed the research themselves. The course will first offer a series of introductory lectures, followed by a series of tutorial sessions in which each student may discuss with experts. Finally, individual student presentations with discussion will be held.

Topics to be offered:

- Novel micro-NMR detectors (solenoid, strip line, microslot, CMOS, printed, etc.)
- Novel nano-MR detectors (MRFM, NV centers, etc.)
- Computation (design optimization, MOR, MRI image processing, NMR spectral prediction, etc.)
- Signal enhancement strategies (hyperpolarization DNP, PHiP, Xe, refrigeration)
- System hyphenation (chromatography, flow cells, LoC, orthogonal analysis, etc.)
- Complex mixtures (metabolomics, in vivo applications on small organisms)
- Biomedical MR sensors (catheters, implantable, etc.)

Workload
Course participation 28 h

Preparation of own lecture 60 h

Self study time 35 h

Literature
Links to allliterature journal articles will be provided to the students. Example research journal sources will include Nature, Nature Communications, Science, PNAS, JMR, etc. For general reading, some recommended sources are:

- Principles of Nuclear Magnetic Resonance Microscopy, Callaghan, P (1994), Oxford University Press.
- Spin Dynamics: Basics of Nuclear Magnetic Resonance 2nd Ed., Levitt, M (2013), John Wiley & Sons.
- NMR Probeheads for Biophysical and Biomedical Experiments – Theoretical Principles, Mispelter, J; Lupu, M; Briguet, A (2006) Imperial College Press.

T 11.266 Course: Microactuators [T-MACH-101910]

Responsible: Prof. Dr. Manfred Kohl
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2142881	Microactuators	2 SWS	Lecture (V)	Kohl
Exams					
SS 2019	76-T-MACH-101910	Microactuators		Prüfung (PR)	Kohl

Competence Certificate
written exam, 60 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Microactuators
2142881, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Script of ppt-slides

Learning Content
- Basic knowledge in the material science of the actuation principles

- Layout and design optimization

- Fabrication technologies

- Selected developments

- Applications

The lecture includes amongst others the following topics:

- Microelectromechnical systems: linear actuators, microrelais, micromotors
- Medical technology and life sciences: Microvalves, micropumps, microfluidic systems
- Microrobotics: Microgrippers, polymer actuators (smart muscle)
- Information technology: Optical switches, mirror systems, read/write heads

Annotation
Details will be announced at the beginning of the lecture

Workload
lecture time 1.5 h/week

self preparation: 8.5 h/week

Literature

- Lecture notes

- D. Jendritza, Technischer Einsatz Neuer Aktoren: Grundlagen, Werkstoffe, Designregeln und Anwendungsbeispiele, Expert-Verlag, 3. Auflage, 2008

- M. Kohl, Shape Memory Microactuators, M. Kohl, Springer-Verlag Berlin, 2004

- N.TR. Nguyen, S.T. Wereley, Fundamentals and applications of Microfluidics, Artech House, Inc. 2002

- H. Zappe, Fundamentals of Micro-Optics, Cambride University Press 2010

T 11.267 Course: Microenergy Technologies [T-MACH-105557]

Responsible: Prof. Dr. Manfred Kohl
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2142897	Microenergy Technologies	2 SWS	Lecture (V)	Kohl
Exams					
SS 2019	76-T-MACH-105557	Microenergy Technologies		Prüfung (PR)	Kohl

Competence Certificate
Oral examination (30 Min.)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Microenergy Technologies
2142897, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
- Basic physical principles of energy conversion
- Layout and design optimization
- Technologies
- Selected devices
- Applications

The lecture includes amongst others the following topics:

Micro energy harvesting of vibrations

Thermal micro energy harvesting

Microtechnical applications of energy harvesting

Heat pumps in micro technology

Micro cooling

Workload
time of attendance: 1.5 hours/week

Self-study: 8.5 hours/week

Literature
- Lecture notes (overhead transparencies) "Micro Energy Technologies"
- Stephen Beeby, Neil White, Energy Harvesting for Autonomous Systems, Artech House, 2010
- Shashank Priya, Daniel J. Inman, Energy Harvesting Technologies, Springer, 2009

T 11.268 Course: Microstructure Characteristics Relationships [T-MACH-105467]

Responsible: Dr. Patric Gruber
Prof. Dr. Oliver Kraft

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2019	2178124	Microstructure Characteristics Relationships	3 SWS	Lecture (V)	Gruber
SS 2019	2178125	Microstructure Characteristics Relationships (Tutorial)	1 SWS	Practice (Ü)	Gruber

Competence Certificate
oral exam, 30 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Microstructure Characteristics Relationships

Lecture (V)

2178124, SS 2019, 3 SWS, Language: German, Open in study portal

Learning Content
The following subjects are treated for the different material classes:

- plasticity
- fracture mechanics: experimental methods and analytical description of crack propagation and material behaviour at cracks
- fatigue: cyclic plasticity, riss initiation and propagation, damage analysis
- creep:time dependent plastic deformation and creep fracture

Besides the description of the material behaviour an overview of the corresponding experimental methods for mechanical characterisation will be given.

T 11.269 Course: Microsystem product design for young entrepreneurs [T-MACH-105814]

Responsible: Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Examination of another type	6	Each winter term	1

Events					
WS 19/20	2141503	Microsystem product design for young entrepreneurs	4 SWS	Practical course (P)	Korvink, Mager

Competence Certificate
The class is a laboratory course that is taken in groups, hence the active and productive participation in the team effort is evaluated. To check the individual performance, there will be weekly discussions about the project. To evaluate each group's progress, there will be 2 presentation during the duration of the course. The final mark is determined from the marks obtained in the presentation and an oral group examination of 1 hour.

Prerequisites
none

T 11.270 Course: Microsystem Simulation [T-MACH-108383]

Responsible: Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2142875	Microsystem Simulation	3 SWS	Lecture / Practice (VÜ)	Korvink

Competence Certificate
written exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Microsystem Simulation

2142875, SS 2019, 3 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)

Learning Content
This lecture consists of the following 12 topics, one presented each week of semester:

1. The Act of Modelling
2. Mathematica Introduction
3. Equation Types
4. Approximation and Integration
5. Differentiation and Finite Differences
6. Geometry and Meshing
7. Weighted Residual Methods
8. Finite Element Method
9. Numerical Solving
10. Computational Post-processing
11. Program Structure
12. Commercial Programs

Attendees will first learn how to approach the modelling process. Afterwards, they will learn the fundamental numerical mathematics techniques with which to form numerical simulation models, which in turn will lead to computational programs. The lecture offers one hour of exercises where students can consult the lecturers on the topics of the lecture. Students are offered numerous learning goals per chapter, to simplify the attendence of lectures.

Students are expected to work with the program Mathematica ® to complete their exercises. It provides a symbolical and numerical environment, and offers high level graphics for ease of programming. All programming exercises will be in Mathematica ®, so as to speed up the learning process.

The written examination questions draw from the examples provided during the lecture (recorded on the slides and on the black board during class) as well as from the exercises.

Annotation
Examinations take place during the lecture free periods. The dates are provided at the beginning of semester.

Workload

lectures: 30 hours

self study: 60 hours

preparation for examination: 30 hours

Literature

The following references are usedby the lecturers to prepare the lecture.Students are not required to access most of these, but of course it does not hurt! Hints for efficient further reading, depending on interest, will be provided during the lecture.

- E. Buckingham, On physically similar systems: illustrations on the use of dimensional equations, Phys. Rev. 4, 345–376 (1914)
- E. Buckingham, Model Experiments and the Forms of Empirical Equations, ASME 263–296 (1915)
- K. Eriksson, D. Estep, P. Hansbo, C. Johnson, Computational Differential Equations, Cambridge University Press, Cambridge (1996)
- Bengt Fornberg, Calculation of Weights in Finite Difference Formulas, SIAM Rev. 40(3) 1998
- Gene H. Golub, Charles F. van Loan, Matrix Computations, John Hopkins University Press 1996
- H. Hanche-Olsen, Buckingham's pi-theorem, Internet (2004)
- Arieh Iserles, A First Course in the Numerical Analysis of Differential Equations, Cambridge University Press, Cambridge (1996)
- Mathematica Help Documentation
- N. Metropolis, A.W. Rosenbluth, M.N. Rosenbluth. A.H. Teller and E. Teller, "Equation of State Calculations by Fast Computing Machines, J. Chem. Phys. 21 (1953) 1087-1092.
- Rick Beatson and Leslie Greengard, A short course on fast multipole methods

T 11.271 Course: Miniaturized Heat Exchangers [T-MACH-108613]

Responsible: Prof. Dr.-Ing. Jürgen Brandner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2142880	Miniaturized Heat Exchangers	2 SWS	Lecture (V)	Brandner

Competence Certificate
oral exam, 20 min.

Prerequisites
none

T 11.272 Course: Mobile Machines [T-MACH-105168]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102630 - Major Field: Mobile Machines

Type	Credits	Recurrence	Version
Oral examination	8	Each summer term	1

Events					
SS 2019	2114073	Mobile Machines	4 SWS	Lecture (V)	Geimer, Geiger
Exams					
SS 2019	76T-MACH-105168	Mobile Machines		Prüfung (PR)	Geimer
SS 2019	76-T-MACH-105168	Mobile Machines		Prüfung (PR)	Geimer
WS 19/20	76T-MACH-105168	Mobile Machines		Prüfung (PR)	Geimer

Competence Certificate
The assessment consists of an oral exam (45 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
none

Recommendation
Knowledge in Fluid Power Systems is required. It is recommended to attend the course *Fluid Power Systems* [2114093] beforehand.

Annotation
After completion of the course the students have knowledge of:

- a wide range of mobile machines
- operation modes and working cycles of importmant mobile machines
- selected subsystems and components

Content:

- Introduction of the required components and machines
- Basics and structure of mobile machines
- Practical insight in the development techniques

Below you will find excerpts from events related to this course:

V Mobile Machines

2114073, SS 2019, 4 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:
Lecture notes.

Learning Content

- Introduction of the required components and machines
- Basics of the structure of the whole system
- Practical insight in the development techniques

Workload

- regular attendance: 42 hours
- self-study: 184 hours

T 11.273 Course: Model Based Application Methods [T-MACH-102199]

Responsible: Dr. Frank Kirschbaum
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Competence Certificate
take-home exam, short presentation with oral examination

Prerequisites
none

T 11.274 Course: Modeling and Simulation [T-MACH-105297]

Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Marcus Geimer
Dr. Balazs Pritz
Prof. Dr.-Ing. Carsten Proppe

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102592 - Modeling and Simulation

Type	Credits	Recurrence	Version
Written examination	7	Each winter term	1

Events					
WS 19/20	2185227	Modelling and Simulation	2 SWS	Lecture (V)	Proppe, Furmans, Pritz, Geimer
WS 19/20	2185228	Übungen zu Modellbildung und Simulation	2 SWS	Practice (Ü)	Proppe, Bykov, Pritz, Völker, Furmans, Bolender, Fischer
Exams					
SS 2019	7600019	Modeling and Simulation		Prüfung (PR)	Proppe, Furmans, Geimer

Competence Certificate
The assessment consists of a 180 minutes written examination.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Modelling and Simulation — Lecture (V)
2185227, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

presentations

Learning Content
Introduction: Overview, concept formation, simulation studies, time/event-discrete models, event-oriented/process orientated/transaction-oriented view, typical model classes (operation/maintenance, storekeeping, loss-susceptible systems)

Time-continuous models with concentrated parameters, model characteristics and model analysis Numerical treatment of ordinary differential equations and differential-algebraic sets of equations coupled simulations with concentrated parameters

Time-continuous models with distributed parameters, description of systems by means of partial differential equations, model reduction, numerical solution procedures for partial differential equations

Annotation
none

Workload
regular attendance: 42 hours
self-study: 168 hours

Literature
None.

T 11.275 Course: Modeling of Thermodynamical Processes [T-MACH-105396]

Responsible: Prof. Dr. Ulrich Maas
Dr.-Ing. Robert Schießl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102635 - Major Field: Engineering Thermodynamics

Type	Credits	Recurrence	Version
Oral examination	6	Each term	1

Events					
SS 2019	2167523	Modeling of Thermodynamical Processes	3 SWS	Lecture (V)	Maas, Schießl
WS 19/20	2167523	Modeling of Thermodynamical Processes	3 SWS	Lecture (V)	Schießl, Maas

Competence Certificate
Oral exam (30 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Modeling of Thermodynamical Processes
2167523, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Thermodynamic basics
Numerical solver strategies for algebraic equations
Optimization issues
Ordinary and partial differential equations
Application to various problems in thermodynamics (engine processes, determination of equilibrium states, unsteady processes in inhomogeneous systems)

Workload
regular attendance: 32 hours

Self-study, exam preporation, Prüfungsvorleistung: 150,0 hours

Literature
Lecture notes

Numerical Recipes C, FORTRAN; Cambridge University Press
R.W. Hamming; Numerical Methods for scientists and engineers; Dover Books On Engineering; 2nd edition; 1973

J. Kopitz, W. Polifke; Wärmeübertragung; Pearson Studium; 1. Auflage

V Modeling of Thermodynamical Processes
2167523, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Thermodynamic basics
Numerical solver strategies for algebraic equations
Optimization issues
Ordinary and partial differential equations
Application to various problems in thermodynamics (engine processes, determination of equilibrium states, unsteady processes in inhomogeneous systems)

Workload
regular attendance: 33.8 h

Self-study, exam preporation, Prüfungsvorleistung: 146.3 h

Literature
Lecture notes

Numerical Recipes C, FORTRAN; Cambridge University Press
R.W. Hamming; Numerical Methods for scientists and engineers; Dover Books On Engineering; 2nd edition; 1973

J. Kopitz, W. Polifke; Wärmeübertragung; Pearson Studium; 1. Auflage

T 11.276 Course: Modelling and Simulation [T-MACH-100300]

Responsible: Prof. Dr. Peter Gumbsch
Prof. Dr. Britta Nestler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Written examination	5	Each term	2

Events					
SS 2019	2183703	Modelling and Simulation	2+1 SWS	Lecture / Practice (VÜ)	Nestler
WS 19/20	2183703	Numerical methods and simulation techniques	3 SWS	Lecture / Practice (VÜ)	Nestler
Exams					
SS 2019	76-T-MACH-100300	Modelling and Simulation		Prüfung (PR)	Nestler
WS 19/20	76-T-MACH-100300	Modelling and Simulation		Prüfung (PR)	Nestler

Competence Certificate
Written exam, 90 min

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Below you will find excerpts from events related to this course:

V Modelling and Simulation

Lecture / Practice (VÜ)

2183703, SS 2019, 2+1 SWS, Language: German, Open in study portal

Description
Media:

Slides and black board. The slides will be provided as a manuscript for the course.

Notes
The course gives an introduction to modelling and simulation techniques.
The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises

The student can

- explain the basic algorithms and numerical methods which are beside other applications relevant for materials simulations.
- describe and apply numerical solution methods for partial differential equations and dynamical systems
- apply numerical methods to solve heat and mass diffusion problems which can also be used to model microstructure formation processes
- has experiences in how to implement and program the introduced numerical methods from an integrated computer lab.

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

We regularly hand out exercise sheets. In addition, the course will be accompanied by practical exercises at the computer.

written examination: 90 minutes

Learning Content
The course gives an introduction to modelling and simulation techniques.
The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises

Workload
regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

Literature

1. Scientific Computing, G. Golub and J.M. Ortega (B.G.Teubner Stuttgart 1996)

V **Numerical methods and simulation techniques** **Lecture / Practice (VÜ)**
2183703, WS 19/20, 3 SWS, Language: German, Open in study portal

Description
Media:

Slides and black board. The slides will be provided as a manuscript for the course.

Notes
The course gives an introduction to modelling and simulation techniques.
The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises

The student can

- explain the basic algorithms and numerical methods which are beside other applications relevant for materials simulations.
- describe and apply numerical solution methods for partial differential equations and dynamical systems
- apply numerical methods to solve heat and mass diffusion problems which can also be used to model microstructure formation processes
- has experiences in how to implement and program the introduced numerical methods from an integrated computer lab.

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

We regularly hand out exercise sheets. In addition, the course will be accompanied by practical exercises at the computer.

written examination: 90 minutes

Learning Content
The course gives an introduction to modelling and simulation techniques.

The following topics are included:

- polynom interpolation methods, splines, Taylor series
- zero point algorithms
- regression methods
- numerical differentiation and integration
- finite difference method
- dynamical systems, ordinary partial differential equations
- numerics of partial differential equations
- mass and heat diffusion equation
- computer lab in the programming language C, practical exercises

In parallel to the lecture, regular exercise sheets are provided and discussed. In addition, the course will be accompanied by practical exercises at the computer. Precondition to register for the written exam is the successful participation in the accompanying computer lab by presenting the solved excercise sheets at the PC.

Workload
regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

Literature

1. Scientific Computing, G. Golub and J.M. Ortega (B.G.Teubner Stuttgart 1996)

T 11.277 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-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102647 - Major Field: Microactuators and Microsensors
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	5	Each winter term	2

Events					
WS 19/20	2183702	Modelling of Microstructures	3 SWS	Lecture / Practice (VÜ)	August, Nestler
Exams					
SS 2019	76-T-MACH-105303	Modelling of Microstructures		Prüfung (PR)	August, Nestler, Weygand

Competence Certificate
oral exam 30 min

Prerequisites
none

Recommendation
materials science
fundamental mathematics

Below you will find excerpts from events related to this course:

V Modelling of Microstructures

Lecture / Practice (VÜ)

2183702, WS 19/20, 3 SWS, Language: German, Open in study portal

Description
Media:

Black board and slides.

Notes

- Brief Introduction in thermodynamics
- Statistical interpretation of entropy
- Gibbs free energy and phase diagrams
- Free energy functional
- Phasefield equation
- Gibbs-Thomson-equation
- Driving forces
- Grand chemical potential functional and the evolution equations
- For compare: Free energy functional with driving forces

The student can

- explain the thermodynamic and statistical foundations for liquid-solid and solid-solid phase transition processes and apply them to construct phase diagrams.
- describe the specific characteristics of dendritic, eutectic and peritectic microstructures.
- explain the mechanisms of grain and phase boundary motion induced by external fields
- use the phase-field method for simulation of microstructure formation processes using modeling approaches and challenges of current research
- has experiences in computing and conduction simulations of microstructure formation from an integrated computer lab.

knowledge in materials science and in fundamental mathematics recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

We regularly hand out exercise sheets. The individual solutions will be corrected.

oral exam ca. 30 min

Learning Content

- Brief Introduction in thermodynamics
- Statistical interpretation of entropy
- Gibbs free energy and phase diagrams
- Free energy functional
- Phasefield equation
- Gibbs-Thomson-equation
- Driving forces
- Grand chemical potential functional and the evolution equations
- For compare: Free energy functional with driving forces

Workload
regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

Literature

1. Gottstein, G. (2007) Physikalische Grundlagen der Materialkunde. Springer Verlag Berlin Heidelberg
2. Kurz, W. and Fischer, D. (1998) Fundamentals of Solidification. Trans Tech Publications ltd, Switzerland Germany UK USA
3. Porter, D.A. Eastering, K.E. and Sherif, M.Y. (2009) Phase transformation in metals and alloys (third edition). CRC Press, Taylor & Francis Group, Boca Raton, London, New York
4. Gaskell, D.R., Introduction to the thermodynamics of materials
5. Problem sheets

T 11.278 Course: Modern Control Concepts I [T-MACH-105539]

Responsible: Dr. Lutz Groell
PD Dr.-Ing. Jörg Matthes

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2105024	Modern Control Concepts I	2 SWS	Lecture (V)	Matthes, Groell
Exams					
SS 2019	76-T-MACH-105539	Modern Control Concepts I		Prüfung (PR)	Matthes

Competence Certificate
Written exam (Duration: 1 h)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Modern Control Concepts I
2105024, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content:

1. Introduction (classification, overviews, model simplification)
2. Simulation and analysis of dynamical systems with Matlab
3. Linearisation (equilibrium manifold, low-delta-method, Hartman-Grobman-theorem, design methodology for linear setpoint controller)
4. Two-degree-of-freedom control (structure, reference signal design)
5. PID-Controller (practical realisation, design hints, anti-windup-methods, Smith-predictor, switching technics, complex example)
6. Multi variable control and advanced control structures
7. State space (geometric view, role of zeros)
8. Tracking control with state feedback and supplemental integrator
9. Observer (LQG-design, disturbance observer, reduced observer)
10. Limits of control (existence subject, limits in time and frequency domain)

Recommendations:

Measurement and control systems

Learning objectives:

After completion this lecture, the students are able

- to analyse linear systems with respect to different properties,
- to design linear feedback systems with feedforward add-on in time and frequency domain under consideration of input saturation, time delay, unmeasurable states and couplings between system parts,
- to use Matlab for simulation, analysis and synthesis in numerical and computeralgebraic way,
- to realise controllers per software in practice

Learning Content

1. Introduction (classification, overviews, model simplification)
2. Simulation and analysis of dynamical systems with Matlab
3. Linearisation (equilibrium manifold, low-delta-method, Hartman-Grobman-theorem, design methodology for linear setpoint controller)
4. Two-degree-of-freedom control (structure, reference signal design)
5. PID-Controller (practical realisation, design hints, anti-windup-methods, Smith-predictor, switching technics, complex example)
6. Multi variable control and advanced control structures
7. State space (geometric view, role of zeros)
8. Tracking control with state feedback and supplemental integrator
9. Observer (LQG-design, disturbance observer, reduced observer)
10. Limits of control (existence subject, limits in time and frequency domain)

Workload
General attendance: 21 h

Self-study: 99 h

Literature

- Aström, K.-J., Murray, R.M.: Feedback Systems, 2012
- Rugh, W.: Linear System Theory. Prentice Hall, 1996

T 11.279 Course: Modern Control Concepts II [T-MACH-106691]

Responsible: Dr. Lutz Groell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2106032	Modern Control Concepts II	2 SWS	Lecture (V)	Groell
Exams					
SS 2019	76-T-MACH-106691	Modern Control Concepts II		Prüfung (PR)	Groell

Competence Certificate
oral exam (Duration: 30min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Modern Control Concepts II

2106032, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Workload
Regular attendance: 30 hours

Self-study: 90 hours

Literature

- Aström, K.-J., Murray, R.M.: Feedback Systems, 2012
- Skogestad, S., Postlethwaite, I.: Multivariable Feedback Control, 2001

T 11.280 Course: Modern Control Concepts III [T-MACH-106692]

Responsible: Dr. Lutz Groell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2106035	Modern Control Concepts III	2 SWS	Lecture (V)	Groell
Exams					
SS 2019	76-T-MACH-106692	Modern Control Concepts III		Prüfung (PR)	Groell

Competence Certificate
oral exam (Duration: 30min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Modern Control Concepts III
2106035, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Workload
Regular attendance: 24 hours

Self-study: 96 hours

Literature

- Khalil, H.: Nonlinear Systems, 1991.
- Krstic, M.; Kanellakopoulos, I.; Kokotovic, P.: Nonlinear and Adaptive Control Design, 1995.

T 11.281 Course: Motor Vehicle Labor [T-MACH-105222]

Responsible: Dr.-Ing. Michael Frey
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course

Type	Credits	Recurrence	Version
Written examination	4	Each term	3

Events					
SS 2019	2115808	Motor Vehicle Laboratory	2 SWS	Practical course (P)	Frey, Knoch
WS 19/20	2115808	Motor Vehicle Laboratory	2 SWS	Practical course (P)	Frey, Knoch
Exams					
SS 2019	76-T-MACH-105222	Motor Vehicle Labor		Prüfung (PR)	Frey, Unrau

Competence Certificate
Colloquium before each experiment

After completion of the experiments: written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Motor Vehicle Laboratory

2115808, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
1. Determination of the driving resistances of a passenger vehicle on a roller dynamometer; measurement of the engine performance of the test vehicle

2. Investigation of a twin-tube and a single-tube shock absorber

3. Behavior of car tyres under longitudinal forces and lateral forces

4. Behavior of car tires on wet road surface

5. Rolling resistance, energy dissipation and high-speed strength of car tires

6. Investigation of the moment transient characteristic of a Visco clutch

Workload
regular attendance: 31,5 hours
self-study: 103,5 hours

Literature
1. Matschinsky, W: Radführungen der Straßenfahrzeuge, Verlag TÜV Rheinland, 1998

2. Reimpell, J.: Fahrwerktechnik: Fahrzeugmechanik, Vogel Verlag, 1992

3. Gnadler, R.: Documents to the Motor Vehicle Laboratory

V **Motor Vehicle Laboratory**
2115808, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
1. Determination of the driving resistances of a passenger vehicle on a roller dynamometer; measurement of the engine performance of the test vehicle

2. Investigation of a twin-tube and a single-tube shock absorber

3. Behavior of car tyres under longitudinal forces and lateral forces

4. Behavior of car tires on wet road surface

5. Rolling resistance, energy dissipation and high-speed strength of car tires

6. Investigation of the moment transient characteristic of a Visco clutch

Workload
regular attendance: 31,5 hours
self-study: 103,5 hours

Literature
1. Matschinsky, W: Radführungen der Straßenfahrzeuge, Verlag TÜV Rheinland, 1998

2. Reimpell, J.: Fahrwerktechnik: Fahrzeugmechanik, Vogel Verlag, 1992

3. Gnadler, R.: Documents to the Motor Vehicle Laboratory

T 11.282 Course: Multi-Scale Plasticity [T-MACH-105516]

Responsible: Dr. Christian Greiner
Dr. Katrin Schulz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Examination of another type	4	Each winter term	2

Events					
WS 19/20	2181750	Multi-scale Plasticity	2 SWS	Lecture (V)	Schulz, Greiner
Exams					
SS 2019	76-T-MACH-105516	Multi-Scale Plasticity		Prüfung (PR)	Schulz

Competence Certificate
presentation (40%) und colloquium (30 min, 60%)

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics, mechanics and materials science

Annotation

- limited number of participants
- mandatory registration
- mandatory attendance

Below you will find excerpts from events related to this course:

V Multi-scale Plasticity

Lecture (V)

2181750, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

black board, beamer, script

Notes
This module will attempt to provide an overview to complex subjects in the field of material mechanics. For this purpose important scientific papers will be presented and discussed.
This will be done by having students read and critique one paper each week in a short review. In addition, each week will include presentation from one of the participants which aim to advocate or criticise each piece of work using the short reviews. He will also be the discussion leader, while students discuss the content, ideas, evaluation and open research questions of the paper. Using a professional conference management system (HotCRP), the student assume the role of reviewers and gain insight into the work of researchers.

The student

- can explain the physical foundations of plasticity as well as results of latest research.
- can independently read and evaluate scientific research papers.
- can present specific, technical information in structured, precise, and readable manner.
- is able to argue for and/or against a particular approach or idea using the knowledge acquired within the lecture.

preliminary knowlegde in mathematics, physics, mechanics and materials science recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

Exam: presentation (40%), oral examination (30 min, 60%)

Learning Content
This module will attempt to provide an overview to complex subjects in the field of material mechanics. For this purpose important scientific papers will be presented and discussed.
This will be done by having students read and critique one paper each week in a short review. In addition, each week will include presentation from one of the participants which aim to advocate or criticise each piece of work using the short reviews. He will also be the discussion leader, while students discuss the content, ideas, evaluation and open research questions of the paper. Using a professional conference management system (HotCRP), the student assume the role of reviewers and gain insight into the work of researchers.

Annotation
The maximum number of students is 14 per semester.

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

T 11.283 Course: Nanotechnology for Engineers and Natural Scientists [T-MACH-105180]

Responsible: Prof. Dr. Martin Dienwiebel
PD Dr. Hendrik Hölscher
Stefan Walheim

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102637 - Major Field: Tribology
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2142861	Nanotechnology for Engineers and Natural Scientists	2 SWS	Lecture (V)	Hölscher, Dienwiebel, Walheim
Exams					
SS 2019	76-T-MACH-105180	Nanotechnology for Engineers and Natural Scientists		Prüfung (PR)	Hölscher, Dienwiebel
WS 19/20	76-T-MACH-105180	Nanotechnology for Engineers and Natural Scientists		Prüfung (PR)	Hölscher, Dienwiebel

Competence Certificate
written exam 90 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Nanotechnology for Engineers and Natural Scientists

Lecture (V)

2142861, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
1) Introduction into nanotechnology
2) History of scanning probe techniques
3) Scanning tunneling microscopy (STM)
4) Atomic force microscopy (AFM)
5) Dynamic Modes (DFM, ncAFM, MFM, KPFM, ...)
6) Friction force microscopy & nanotribology
7) Nanolithography
8) Other families of the SPM family

The student can

- explain the most common measurement principles of nanotechnology especialy scanning probe methods and is able to use them for the characterisation of chemical and physical properties of surfaces
- decribe interatomic forces and their influence on nanotechnology
- describe methods of micro- and nanofabrication and of –nanolithography
- explain simple models used in contact mechanics and nanotribology
- describe basic concepts used for nanoscale components

preliminary knowlegde in mathematics and physics

lectures 30 h

self study 30 h

preparation for examination 30 h

The successfull attandence of the lecture is controlled by a 30 minutes written examination, and a subsequent oral examination (20 min). Passing the written exam is mandantory for the participation of the oral examination. The grade result is the result of the oral exam.

Learning Content
1) Introduction into nanotechnology
2) History of scanning probe techniques
3) Scanning tunneling microscopy (STM)
4) Atomic force microscopy (AFM)
5) Dynamic Modes (DFM, ncAFM, MFM, KPFM, ...)
6) Friction force microscopy & nanotribology
7) Nanolithography
8) Other families of the SPM family

Workload
lectures 30 h

self study 30 h

preparation for examination 30 h

Literature

1. Lecture notes, slides, script
2. Scanning Probe Microscopy – Lab on a Tip: Meyer, Hug, Bennewitz, Springer (2003)

T 11.284 Course: Nanotribology and -Mechanics [T-MACH-102167]

Responsible: Prof. Dr. Martin Dienwiebel
PD Dr. Hendrik Hölscher

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102637 - Major Field: Tribology

Type	Credits	Recurrence	Version
Examination of another type	4	Each summer term	4

Events					
SS 2019	2182712	Nanotribology and -Mechanics	2 SWS	Lecture / Practice (VÜ)	Dienwiebel
WS 19/20	2182712	Nanotribology and -Mechanics	2 SWS	Block (B)	Dienwiebel
Exams					
SS 2019	76-T-MACH-102167	Nanotribology and -Mechanics		Prüfung (PR)	Dienwiebel

Competence Certificate
presentation (40%) and colloquium (30 min, 60%)

no tools or reference materials

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics and physics

Below you will find excerpts from events related to this course:

V Nanotribology and -Mechanics
2182712, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes
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

Learning Content
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

Workload
regular attendance: 22,5 hours
preparation for presentation: 22,5 hours
self-study: 75 hours

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

Lecture notes, slides and copies of articles

V **Nanotribology and -Mechanics** **Block (B)**
2182712, WS 19/20, 2 SWS, Language: English, Open in study portal

Notes
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

Learning Content
Part 1: Basics:

- Nanotechnology
- Forces at nanometer scale
- contact mechanics models (Hertz, JKR, DMT)
- Experimental methods (SFA, QCM, FFM)
- Prandtl-Tomlinson model
- Superlubricity
- Atomic-Scale Wear

Part 2: Topical papers

Workload
regular attendance: 22,5 hours
preparation for presentation: 22,5 hours
self-study: 75 hours

Literature
Lecture notes, slides and copies of articles

T 11.285 Course: Neurovascular Interventions (BioMEMS V) [T-MACH-106747]

Responsible: Dr.-Ing. Giorgio Cattaneo
Prof. Dr. Andreas Guber

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2141103	BioMEMS V - Microfuidic Chip Systems	2 SWS	Lecture (V)	Rajabi, Guber
Exams					
SS 2019	76-T-MACH-106747	Neurovascular Interventions (BioMEMS V)		Prüfung (PR)	Guber

Competence Certificate
oral exam (30 Min.)

Prerequisites
none

T 11.286 Course: Neutron Physics of Fusion Reactors [T-MACH-105435]

Responsible: Dr. Ulrich Fischer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189473	Neutron physics of fusion reactors	2 SWS	Lecture (V)	Fischer
Exams					
SS 2019	76-T-MACH-105435	Neutron Physics of Fusion Reactors		Prüfung (PR)	Stieglitz, Fischer
WS 19/20	76-T-MACH-105435	Neutron physics of fusion reactors		Prüfung (PR)	Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Annotation
none

Below you will find excerpts from events related to this course:

V Neutron physics of fusion reactors
2189473, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Nuclear interaction processes and energy release
Chain reaction and criticality
Neutron transport, Boltzmann equation
Diffusion approximation, Monte Carlo method
Neutronic reactor design

The aim of this lecture is to provide the neutron physics principles required for analysis of nuclear fission and fusion reactors. First of all, the basic nuclear interaction processes are presented which are important for the physical behaviour of the reactors. Next the neutron transport phenomenon in matter is described by means of the Boltzmann transport equation. Suitable mathematical solution methods are presented such as the diffusion approximation for nuclear fission reactors and the Monte Carlo method for fusion reactors. The knowledge acquired will eventually be used to solve neutron physics problems related to the design and optimization of the reactors.

oral exam, duration: approximately 30 minutes, no tools or reference materials may be used during the exam

regular attendance: 21 h
self-study: 42 h

Admission to Campus North is required, please register to attend the lecture at: il-sekretariat@inr.kit.edu

Learning Content
Nuclear interaction processes and energy release

Chain reaction and criticality

Neutron transport, Boltzmann equation

Diffusion approximation, Monte Carlo method

Neutronic reactor design

Workload
regular attendance: 21 h
self-study: 42 h

Literature
K. H. Beckurts, K. Wirtz, Neutron Physics, Springer Verlag, Berlin, Germany (1964)

W. M. Stacey, Nuclear Reactor Physics, John Wiley & Sons, Wiley-VCH, Berlin(2007)

J. Raeder (Ed.), Kontrollierte Kernfusion. Grundlagen ihrer Nutzung zur Energieversorgung, Teubner, Stuttgart (1981)

T 11.287 Course: NMR micro probe hardware conception and construction [T-MACH-108407]

Responsible: Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2142551	NMR micro probe hardware conception and construction	2 SWS	Practical course (P)	Korvink, Jouda

Competence Certificate
Successful participation.

Prerequisites
none

Below you will find excerpts from events related to this course:

V NMR micro probe hardware conception and construction
2142551, SS 2019, 2 SWS, Language: English, Open in study portal

Practical course (P)

Description
The aim of this practical block course is to familiarize the students with magnetic resonance imaging as a substantial non-invasive non-destructive imaging technique that is widely used for medical diagnosis.

It is also to give them hands-on experience on how to build the MRI probe from A to Z including

- Mechanical design
- High frequency electrical circuitry
- Testing on a commercial MRI scanner

Learning Content
In order to prepare attendees, the following chapters will be offered, spread over the week as lecture units, and accompanying the practical work:

- Theory of magnetic resonance imaging

-The MRI probe and the principle of reciprocity

- RF resonators

- Coaxial cables and cable traps

- Tuning and matching the MRI probe

- Effects of material susceptibility

- The mechanical support of the MRI probe

- Introduction to ParaVision, the MRI imaging software.

T 11.288 Course: Nonlinear Continuum Mechanics [T-MACH-105532]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102649 - Major Field: Advanced Materials Modelling

Type	Credits	Recurrence	Version
Oral examination	5	Each summer term	2

Events					
SS 2019	2162344	Nonlinear Continuum Mechanics	2 SWS	Lecture (V)	Böhlke

Competence Certificate
oral examination (approx. 25 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Nonlinear Continuum Mechanics — Lecture (V)
2162344, SS 2019, 2 SWS, Language: English, Open in study portal

Learning Content

- tensor calculus, kinematics, balance equations
- principles of material theory
- finite elasticity
- infinitesimal elasto(visco)plasticity
- exact solutions ov infinitesimal Platicity
- finite elasto(visco)plasticity
- infinitesimal and finite crystal(visco)plasticity
- hardening and failure
- strain localization

Workload
regular attendance: 31,5 hours
self-study: 118 hours

Literature
lecture notes

Bertram, A.: Elasticity and Plasticity of Large Deformations - an Introduction. Springer 2005.
Liu, I-S.: Continuum Mechanics. Springer 2002.
Schade, H.: Tensoranalysis.Walter de Gruyter 1997.
Wriggers, P.: Nichtlineare Finite-Element-Methoden. Springer 2001.

T 11.289 Course: Nonlinear optimization methods [T-MACH-110380]

Responsible: Prof. Dr. Matti Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Expansion	Version
Oral examination	6	Each winter term	1 terms	1

Events					
WS 19/20	2161130	Nonlinear optimization methods (Lecture)	2 SWS	Lecture (V)	Schneider

Competence Certificate
Oral examination

Below you will find excerpts from events related to this course:

V Nonlinear optimization methods (Lecture)

2161130, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
- The method of Newton-Kantorovich
- Gradient methods and their accelerations
- Constrained optimization
- Modern operator splitting schemes

T 11.290 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-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102616 - Major Field: Microsystem Technology
M-MACH-102633 - Major Field: Robotics
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools
M-MACH-102647 - Major Field: Microactuators and Microsensors
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	3

Events					
WS 19/20	2141865	Novel actuators and sensors	2 SWS	Lecture (V)	Kohl, Sommer

Competence Certificate
written exam, 60 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Novel actuators and sensors

2141865, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Script / script of ppt foils (part 2)

Learning Content
Contents: - Basic knowledge in the material science of actuator and sensor principles

- Layout and design optimization

- Fabrication technologies

- Selected developments

- Applications

Index: The lecture includes amongst others the following topics:

- Piezo actuators
- Magnetostrictive actuators
- Shape memory actuators
- Electro-/magnetorheological actuators
- Sensors: Concepts, materials, fabrication
- Micromechanical sensors: Pressure, force, inertia sensors
- Temperature sensors
- Micro sensors for bio analytics
- Mechano-magnetic sensors

The lecture addresses students in the fields of mechanical engineering, mechatronics and information technology, materials science and engineering, electrical engineering and economic sciences. A comprehensive introduction is given in the basics and current developments on the macroscopic length scale.

The lecture is core subject of the major course "Actuators and Sensors" of the specialization "Mechatronics and Microsystems Technology" in Mechanical Engineering.

Workload
Work Lecture:

time of attendance: 21 hours

Self-study: 99 hours

Literature
- Lecture notes

- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007

- "Sensors Update", Edited by H.Baltes, W. Göpel, J. Hesse, VCH, 1996, ISBN: 3-527-29432-5

- "Multivariate Datenanalyse – Methodik und Anwendungen in der Chemie", R. Henrion, G. Henrion, Springer 1994, ISBN 3-540-58188-X

T 11.291 Course: Nuclear Fusion Technology [T-MACH-110331]

Responsible: Dr. Aurelian Florin Badea
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102608 - Major Field: Nuclear Energy

Type	Credits	Expansion	Version
Oral examination	4	1 terms	1

Events					
WS 19/20	2189920	Nuclear Fusion Technology	2 SWS	Lecture (V)	Badea
Exams					
WS 19/20	76-T-MACH-110331	Nuclear Fusion Technology		Prüfung (PR)	Badea

Competence Certificate
oral exam, approx. 20 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Nuclear Fusion Technology

2189920, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
nuclear fission & fusion
neutronics for fusion
fuel cycles, cross sections
gravitational, magnetic and inertial confinement
fusion experimental devices
energy balance for fusion systems; Lawson criterion and Q-factor
materials for fusion reactors
plasma physics, confinement
plasma heating
timeline of the fusion technology
ITER, DEMO
safety and waste management

Workload
120 h

T 11.292 Course: Nuclear Medicine and Measuring Techniques I [T-ETIT-100664]

Responsible: Prof. Dr. Olaf Dössel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Oral examination	1	Each winter term	1

Events					
WS 19/20	2305289	Nuclear Medicine and Measuring Techniques I	1 SWS	Lecture (V)	Maul, Doerfel

Prerequisites
none

T 11.293 Course: Nuclear Power and Reactor Technology [T-MACH-110332]

Responsible: Dr. Aurelian Florin Badea
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102608 - Major Field: Nuclear Energy

Type	Credits	Expansion	Version
Oral examination	4	1 terms	1

Events					
WS 19/20	2189921	Nuclear Power and Reactor Technology	3 SWS	Lecture (V)	Badea
Exams					
WS 19/20	76-T-MACH-110332	Nuclear Power and Reactor Technology		Prüfung (PR)	Badea

Competence Certificate
oral exam, approx. 20 min.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Nuclear Power and Reactor Technology

2189921, WS 19/20, 3 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
nuclear fission & fusion,
radioactive decay, neutron excess, fission, fast and
thermal neutrons, fissile and fertile nuclei,
enrichment,
neutron flux, cross section, reaction rate, mean free path,
chain reaction, critical size, moderation,
reactor dynamics,
transport- and diffusion-equation for the neutron flux distribution,
power distributions in reactor,
one-group and two-group theories,
light-water reactors,
reactor safety,
design of nuclear reactors,
breeding processes,
nuclear power systems of generation IV

Workload
regular attendance: 30 h
self-study: 150 h

T 11.294 Course: Nuclear Power Plant Technology [T-MACH-105402]

Responsible: Dr. Aurelian Florin Badea
Prof. Dr.-Ing. Xu Cheng
Prof. Dr.-Ing. Thomas Schulenberg

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy
M-MACH-102610 - Major Field: Power Plant Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2170460	Nuclear Power Plant Technology	2 SWS	Lecture (V)	Cheng, Schulenberg
Exams					
SS 2019	76-T-MACH-105402	Nuclear Power Plant Technology		Prüfung (PR)	Cheng, Schulenberg

Competence Certificate
oral exam, Duration: approximately 30 minutes

no tools or reference materials may be used during the exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Nuclear Power Plant Technology
2170460, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Description
Powerpoint presentations

PWR simulator

BWR simulator

Notes

The training objective of the course is the qualification for a research-related professional activity in nuclear power plant engineering. The participants can describe the most important components of nuclear power plants and their function. You can design or modify nuclear power plants independently and creatively. They have acquired a broad knowledge of this power plant technology, including specific knowledge of core design, design of primary and secondary systems, and of nuclear safety technologies. Based on the acquired knowledge in thermodynamics and neutron physics, they can describe and analyze the specific behavior of the nuclear power plant components and assess risks. Participants of the lecture have a trained analytical thinking and judgment in the design of nuclear power plants.

Power plants with pressurized water reactors:

Design of the pressurized water reactor

- Fuel assemblies
- Control rods and drives
- Core instrumentation
- Reactor pressure vessel and its internals

Components of the primary system

- Primary coolant pumps
- Pressurizer
- Steam generator
- Water make-up system

Secondary system:

- Turbines
- Reheater
- Feedwater system
- Cooling systems

Containment

- Containment design
- Components of safety systems
- Components of residual heat removal systems

Control of a nuclear power plant with PWR

Power plants with boiling water reactors:

Design of the boiling water reactor

- Fuel assemblies
- Control elements and drives
- Reactor pressure vessel and its internals

Containment and components of safety systems

Control of a nuclear power plant with boiling water reactors

Learning Content
Power plants with pressurized water reactors:

Design of the pressurized water reactor

- Fuel assemblies
- Control rods and drives
- Core instrumentation
- Reactor pressure vessel and its internals

Components of the primary system

- Primary coolant pumps
- Pressurizer
- Steam generator
- Water make-up system

Secondary system:

- Turbines
- Reheater
- Feedwater system
- Cooling systems

Containment

- Containment design
- Components of safety systems
- Components of residual heat removal systems

Control of a nuclear power plant with PWR

Power plants with boiling water reactors:

Design of the boiling water reactor

- Fuel assemblies
- Control elements and drives
- Reactor pressure vessel and its internals

Containment and components of safety systems

Control of a nuclear power plant with boiling water reactors

Annotation
Recommendations:

Knowledge of thermodynamics are a mandatory requirement for this course.

Basic knowledge of the physics of nuclear fission wiill be helpful.

Simulator exercises with a simplified pressurized water reactor and a simplified boiling water reactor are offered to ease understanding of thermodynamics and neutron physics.

Workload
regular attendance: 48 h
self-study: 72 h

Literature
lecture notes

T 11.295 Course: Numerical Fluid Mechanics [T-BGU-106758]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo- and Environmental Sciences
Part of: M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Written examination	6	Each term	2

Events					
WS 19/20	6221702	Numerical Fluid Mechanics I	4 SWS	Lecture / Practice (VÜ)	Uhlmann
Exams					
SS 2019	8244106758	Numerical Fluid Mechanics		Prüfung (PR)	Uhlmann

Competence Certificate
written exam, 90 min.

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105338 - Numerical Fluid Mechanics must not have been started.

Recommendation
none

Annotation
none

T 11.296 Course: Numerical Fluid Mechanics [T-MACH-105338]

Responsible: Dr.-Ing. Franco Magagnato
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2153441	Numerical Fluid Mechanics	2 SWS	Lecture (V)	Magagnato
Exams					
WS 19/20	76T-Mach-105338	Numerical Fluid Mechanics		Prüfung (PR)	Frohnapfel, Magagnato

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-106758 - Numerical Fluid Mechanics must not have been started.

Below you will find excerpts from events related to this course:

V Numerical Fluid Mechanics

2153441, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:
"Powerpoint presentation", Beamer

Notes

The students can describe the modern numerical simulation methods for fluid flows and can explain their relevance for industrial projects. They can choose appropriate boundary and initial conditions as well as turbulence models. They are qualified to explain the meaning of suitable meshes for processed examples. Convergence acceleration techniques like multi grid, implicit methods etc. as well as the applicability of these methods to parallel and vector computing can be described by the students. They can identify problems that occur during application of these methods and can discuss strategies to avoid them. The students are qualified to apply commercial codes like Fluent, Star-CD, CFX etc. as well as the research code SPARC. They can describe the differences between conventional methods (RANS) and more advanced approaches like Large Eddy Simulation (LES) and Direct Numerical Simulation (DNS).

1. Governing Equations of Fluid Dynamics
2. Discretization
3. Boundary and Initial conditions
4. Turbulence Modelling
5. Mesh Generation
6. Numerical Methods
7. LES, DNS and Lattice Gas Methods
8. Pre- and Postprocessing
9. Examples of Numerical Methods for Industrial Applications

Learning Content

1. Governing Equations of Fluid Dynamics
2. Discretization
3. Boundary and Initial conditions
4. Turbulence Modelling
5. Mesh Generation
6. Numerical Methods
7. LES, DNS and Lattice Gas Methods
8. Pre- and Postprocessing
9. Examples of Numerical Methods for Industrial Applications

Workload

regular attendance: 22,5 hours
self-study: 97,5 hours

Literature

Ferziger, Peric: Computational Methods for Fluid Dynamics. Springer-Verlag, 1999.
Hirsch: Numerical Computation of Internal and External Flows. John Wiley & Sons Inc., 1997.
Versteg, Malalasekera: An introduction to computational fluid dynamics. The finite volume method. John Wiley & Sons Inc., 1995

T 11.297 Course: Numerical Fluid Mechanics with MATLAB [T-MACH-105453]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2154409	Numerical Fluid Mechanics with MATLAB	2 SWS	Practical course (P)	Stroh, Gatti, Frohnapfel
Exams					
SS 2019	76-T-MACH-105453	Numerical Fluid Mechanics with MATLAB		Prüfung (PR)	Frohnapfel, Gatti

Competence Certificate
ungraded homework

Prerequisites
none

Below you will find excerpts from events related to this course:

V Numerical Fluid Mechanics with MATLAB

2154409, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Description
Media:

Power Point, workstations: independent programming

Learning Content
Numerical Fluid Mechanics with Matlab

- Introduction to Numerics and Matlab
- Finite-Difference-Method
- Finite-Volume-Method
- boundary conditions and intial conditions
- explicit and implicite schemes
- pressure correction

Annotation
Block course with limited number of participants, registration in the secretary's office required. See details at www.istm.kit.edu

Workload
attendance: 20h

self-study: 100h

Literature
H. Ferziger, M. Peric, *Computational Methods for Fluid Dynamics*, Springer, 2008

T 11.298 Course: Numerical Mathematics for Students of Computer Science [T-MATH-102242]

Responsible: Prof. Dr. Andreas Rieder
Dr. Daniel Weiß
Prof. Dr. Christian Wieners

Organisation: KIT Department of Mathematics

Part of: M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102594 - Mathematical Methods
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	6	Each term	3

Events					
SS 2019	0187400	Numerische Mathematik für die Fachrichtungen Informatik und Ingenieurwesen	2 SWS	Lecture (V)	Weiß
SS 2019	0187500	Übungen zu 0187400	1 SWS	Practice (Ü)	Weiß
Exams					
SS 2019	770100085	Numerical Mathematics for Students of Computer Science		Prüfung (PR)	Weiß

Competence Certificate
written exam, 120 min.

Prerequisites
none

T 11.299 Course: Numerical Mechanics for Industrial Applications [T-MACH-108720]

Responsible: Prof. Dr. Eckart Schnack
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2162298	Numerical mechanics for industrial applications	3 SWS	Lecture (V)	Schnack
Exams					
SS 2019	76-T-MACH-108720	Numerical Mechanics for Industrial Applications		Prüfung (PR)	

Competence Certificate
Oral exam, 20 minutes

Prerequisites
None

Below you will find excerpts from events related to this course:

V Numerical mechanics for industrial applications

2162298, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Brief overview of finite element methods. Structure of boundary element methods (BEM). Explanation of hybrid tension methods. Higher-grade finite element processes. Non-linear FEM processes.

Workload
Contact time: 33.75 hrs; Self-study: 127 hrs

T 11.300 Course: Numerical Simulation of Multi-Phase Flows [T-MACH-105420]

Responsible: Dr. Martin Wörner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2130934	Numerical Modeling of Multiphase Flows	2 SWS	Lecture (V)	Wörner
Exams					
SS 2019	76-T-MACH-105420	Numerical Simulation of Multi-Phase Flows		Prüfung (PR)	Frohnapfel

Competence Certificate
oral exam 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Numerical Modeling of Multiphase Flows

2130934, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

1. Introduction in the subject of multi-phase flows (terms and definitions, examples)
2. Physical fundamentals (dimensionless numbers, phenomenology of single bubbles, conditions at fluid interfaces, forces on a suspended particle)
3. Mathematical fundamentals (governing equations, averaging, closure problem)
4. Numerical fundamentals (discretization in space and time, truncation error and numerical diffusion)
5. Models for interpenetrating continua (homogeneous model, algebraic slip model, standard two-fluid model and its extensions)
6. Euler-Lagrange model (particle equation of motion, particle response time, one-/two-/four-way coupling)
7. Interface resolving methods (volume-of-fluid, level-set and front-capturing method)

Annotation
For some topics of the lecture exercises are provided (working on them is optional).

Workload
regular attendance: 21h

self-study: 99h

Literature
A brief script can be downloaded from http://bibliothek.fzk.de/zb/berichte/FZKA6932.pdf.

Powerpoint presentations can be downloaded after each lecture from the ILIAS system.

A list of recommended books is provided in the first lecture.

T 11.301 Course: Numerical Simulation of Reacting Two Phase Flows [T-MACH-105339]

Responsible: Dr.-Ing. Rainer Koch
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102634 - Major Field: Fluid Mechanic
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2169458	Numerical simulation of reacting two phase flows	2 SWS	Lecture (V)	Koch
Exams					
WS 19/20	76-T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows		Prüfung (PR)	Koch

Competence Certificate
Oral exam
Duration: approximately 30 minutes

no tools or reference materials are allowed

Prerequisites
none

Below you will find excerpts from events related to this course:

V Numerical simulation of reacting two phase flows

2169458, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
The course is devoted to diploma/master students and doctoral candidates of mechanical and chemical engineering. It gives an overview of the numerical methods used for CFD of single and two phase flows. The course introduces methods for reacting single and two phase flows, as they are typically found in gas turbines and piston engines operated by liquid fuel.

1. Single phase flow: Basic equations of fluid dynamics, Turbulence: DNS, LES, RANS; Finite volume methods, Numerical solvers.

2. Two phase flows: Basics of atomisation, Characterisation of sprays, Numerical prediction of droplet movement, Numerical methods for predicitng of liquid disintegration (VoF, SPH), Numerical methods for secondary atomisation; Droplet evaporation

3. Reacting flows: Combustion models; Single droplet combustion, Spray combustion.

Workload
regular attendance: 21 h
self-study: 42 h

Literature
Lecture notes

T 11.302 Course: Numerical Simulation of Turbulent Flows [T-MACH-105397]

Responsible: Dr. Günther Grötzbach
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102604 - Major Field: Computational Mechanics
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153449	Numerical Simulation of Turbulent Flows	3 SWS	Lecture (V)	Grötzbach
Exams					
SS 2019	76-T-MACH-105397	Numerical Simulation of Turbulent Flows		Prüfung (PR)	Grötzbach

Competence Certificate
oral

Duration: 30 minutes

no auxiliary means

Prerequisites
none

Recommendation
Basics in fluid mechanics

Below you will find excerpts from events related to this course:

V Numerical Simulation of Turbulent Flows

2153449, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

black board, plus pictures, movies, and script in English (distributed chapter by chapter)

Notes
The students are qualified to describe the fundamentals of direct numerical simulation (DNS) and large eddy simulation (LES) of turbulent flows. They understand the principle differences between these simulation methods and the respective properties of the conventional turbulence modelling approaches basing on Reynolds Averaged Navier-Stokes equations (RANS). They can describe subgrid scale models, peculiarities of wall and inlet/outlet modelling, suitable numerical solution schemes and evaluation methods. They have obtained the knowledge and understanding required to identify the best modelling approach (among the available methods) for the problem at hand, thus being able to solve given thermal and fluid dynamical problems appropriately.

The lecture series will introduce in following subjects of the turbulence simulation method:

- Appearance of turbulence and deduction of requirements and limits of the simulation method.
- Conservation equations for flows with heat transfer, filtering them in time or space.
- Some subgrid scale models for small scale turbulence and their physical justification.
- Peculiarities in applying boundary and initial conditions.
- Suitable numerical schemes for integration in space and time.
- Statistical and graphical methods to analyse the simulation results.
- Application examples for turbulence simulations in research and engineering

Learning Content
The lecture series will introduce in following subjects of the turbulence simulation method:

- Appearance of turbulence and deduction of requirements and limits of the simulation method.
- Conservation equations for flows with heat transfer, filtering them in time or space.
- Some subgrid scale models for small scale turbulence and their physical justification.
- Peculiarities in applying boundary and initial conditions.
- Suitable numerical schemes for integration in space and time.
- Statistical and graphical methods to analyse the simulation results.
- Application examples for turbulence simulations in research and engineering

Annotation
Recommendations: basics in fluid mechanics

Workload
regulare attendance: 29h

self-study: 91h

Literature
J. Piquet, *Turbulent Flows – Models and Physics,* Springer, Berlin (2001)

J. Fröhlich, *Large Eddy Simulation turbulenter Strömungen.* Lehrbuch Maschinenbau, B.G. Teubner Verlag, Wiesbaden (2006)

P. Sagaut, C. Meneveau, *Large-eddy simulation for incompressible flows: An introduction.* Springer Verlag (2010)

G. Grötzbach, *Revisiting the Resolution Requirements for Turbulence Simulations in Nuclear Heat Transfer.* Nuclear Engineering & Design Vol. 241 (2011) pp. 4379-4390

G. Grötzbach,Script in English

T 11.303 Course: Occupational Safety and Environmental Protection [T-MACH-105386]

Responsible: Rainer von Kiparski
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102610 - Major Field: Power Plant Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2110037	Occupational Safety and Environmental Protection	2 SWS		von Kiparski
Exams					
SS 2019	76-T-MACH-105386	Occupational Safety and Environmental Protection		Prüfung (PR)	Deml

Competence Certificate
oral exam (approx. 30 min)

The exam is offered in German only!

Prerequisites
none

Below you will find excerpts from events related to this course:

V Occupational Safety and Environmental Protection
2110037, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
The participants have to solve a specific case study within the field of occupational safety and environmental protection. Therefore, they work in a team. The course work covers the information research as well as the presentation of the results.

Content:

- Occupational Safety and Safety Engineering
- Environmental Protection within a Production Enterprise
- Health Management

Structure:

- Terminology
- Basics of Occupational Safety and Environmental Protection
- Case Study
- Moderated Processing of a Case Stuy within a Small Group

Learning Content
The participants have to solve a specific case study within the field of occupational safety and environmental protection. Therefore, they work in a team. The course work covers the information research as well as the presentation of the results.

Content:

- Occupational Safety and Safety Engineering
- Environmental Protection within a Production Enterprise
- Health Management

Structure:

- Terminology
- Basics of Occupational Safety and Environmental Protection
- Case Study
- Moderated Processing of a Case Stuy within a Small Group

Workload
Compact course (one week full-time).

The amount of work accounts for 120 h (=4 ECTS).

Literature
Handout and literature are available on ILIAS for download.

T 11.304 Course: Optical Flow Measurement: Fundamentals and Applications [T-MACH-105424]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Prof. Dr.-Ing. Friedrich Seiler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153410	Optical Flow Measurement: Fundamentals and Applications	2 SWS	Lecture (V)	Seiler
Exams					
WS 19/20	76-T-MACH-105424	Optical Flow Measurement: Fundamentals and Applications		Prüfung (PR)	Seiler

Competence Certificate
oral exam 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Optical Flow Measurement: Fundamentals and Applications

Lecture (V)

2153410, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Power Point

Notes
The students can thoroughly describe the introduced optical measurement techniques. From recently achieve results in shock tunnels, they are able to explain the working principle(s) of the most important registration and visualization methods working with either tracer scattering or with the information obtained with light passing directly the measuring regime. Particularly, the students are qualified to comparatively discuss the measurement techniques for velocity, density and gas temperature (listed below) and can furthermore illustrate their working principles with examples:

- shadowgraph techniques
- Schlieren method
- Mach/Zehnder- and Differential interferometer
- Particle Image Velocimetry (PIV)
- Doppler Global Velocimetry (DGV)
- Doppler picture velocimetry (DPV)
- classical single-beam
- cross-beam anemometry
- interference velocimetry
- CARS-method
- laser-induced fluorescence (LIF)

- Visualisierungsverfahren
- Registrierungsverfahren
- Lichtstreuverfahren
- Fluoreszenzverfahren

Learning Content

- Visualisations techniques
- Techniques for local point-wise measurement
- Techniques using light scattering methods
- Laser-induced fluorescence

Workload
regular attendance: 21h
self-study: 99h

Literature
H. Oertel sen., H. Oertel jun.: Optische Strömungsmeßtechnik, G. Braun, Karlsruhe

F. Seiler: Skript zur Vorlesung über Optische Strömungsmeßtechnik

T 11.305 Course: Organ Support Systems [T-MACH-105228]

Responsible: Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2106008	Organ support systems	2 SWS	Lecture (V)	Pylatiuk
Exams					
SS 2019	76-T-MACH-105228	Organ Support Systems		Prüfung (PR)	Pylatiuk

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Organ support systems
2106008, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content:

- Introduction: Definitions and classification of organ support and replacement.
- Special topics: acoustic and visual prostheses, exoskeletons, neuroprostheses, tissue-engineering, hemodialysis, heart-lung machine, artificial hearts, biomaterials.

Learning objectives:

Students have fundamental knowledge about functionality of organ support systems and its components. An analysis of historical developments can be done and limitations of current systems can be found. The limits and possibilities of transplantations can be elaborated.

Learning Content

- Introduction: Definitions and classification of organ support and replacement.
- Special topics: acoustic and visual prostheses, exoskeletons, neuroprostheses, tissue-engineering, hemodialysis, heart-lung machine, artificial hearts, biomaterials.

Workload
General attendance: 21 h

Self-study: 99 h

Literature

- Jürgen Werner: Kooperative und autonome Systeme der Medizintechnik: Funktionswiederherstellung und Organersatz. Oldenbourg Verlag.
- Rüdiger Kramme: Medizintechnik: Verfahren - Systeme – Informationsverarbeitung. Springer Verlag.
- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.

11.306 Course: Patent Law [T-INFO-101310]

Responsible: Prof. Dr. Thomas Dreier
Organisation: KIT Department of Informatics
Part of: M-MACH-102596 - Compulsory Elective Subject Economics/Law

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	24656	Patent Law	2 SWS	Lecture (V)	Koch
Exams					
SS 2019	7500062	Patent Law		Prüfung (PR)	Dreier, Matz
WS 19/20	7500001	Patent Law		Prüfung (PR)	Dreier, Matz

T 11.307 Course: Photovoltaic System Design [T-ETIT-100724]

Responsible: Robin Grab
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102648 - Major Field: Energy Technology for Buildings

Type	Credits	Version
Written examination	3	1

Events					
SS 2019	2307380	Photovoltaische Systemtechnik	2 SWS	Lecture (V)	Grab
Exams					
SS 2019	7307380	Photovoltaics		Prüfung (PR)	Leibfried

Prerequisites
none

11.308 Course: Photovoltaics [T-ETIT-101939]

Responsible: Prof. Dr.-Ing. Michael Powalla
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	2

Events					
SS 2019	2313737	Photovoltaics	4 SWS	Lecture (V)	Powalla, Lemmer
Exams					
SS 2019	7313737	Photovoltaics		Prüfung (PR)	Powalla, Lemmer

Prerequisites
"M-ETIT-100524 - Solar Energy" must not have started.

T 11.309 Course: Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle [T-MACH-105537]

Responsible: Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102623 - Major Field: Fundamentals of Energy Technology

Type	Credits	Recurrence	Version
Oral examination	2	Each winter term	2

Events					
WS 19/20	2189906	Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle	1 SWS	Lecture (V)	Dagan
Exams					
SS 2019	76-T-MACH-105537	Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle		Prüfung (PR)	Dagan, Stieglitz
WS 19/20	76-T-MACH-105537	Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle		Prüfung (PR)	Dagan, Stieglitz

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle

Lecture (V)

2189906, WS 19/20, 1 SWS, Language: German, Open in study portal

Notes

- Relevant physical terms of nuclear physics
- Decay heat removal- Borst-Wheeler equation
- The accidents in TMI- Three Mile Island, and Fukushima .
- Fission , chain reaction and reactor control systems
- Basics of nuclear cross sections
- Principles of reactor dynamics
- Reactor poisoning
- The Idaho and Chernobyl accidents
- Principles of the nuclear fuel cycle
- Reprocessing of irradiated fuel elements and vitrification of fission product solutions
- Interim storage of nuclear residues in surface facilities
- Multi barrier concepts for final disposal in deep geological formations
- The situation in the repositories Asse II, Konrad and Morsleben

The students

- understand the physical explanations of the known nuclear accidents
- can perform simplified calculations to demonstrate the accidents outcome.
- Define safety relevant properties of low/ intermediate / high level waste products
- Are able to evaluate principles and implications of reprocessing, storage and disposal options for nuclear waste.

Regular attendance: 14 h
self study 46 h
oral exam about 20 min.

Learning Content

- Relevant physical terms of nuclear physics
- Decay heat removal- Borst-Wheeler equation
- The accidents in TMI- Three Mile Island, and Fukushima .
- Fission , chain reaction and reactor control systems
- Basics of nuclear cross sections
- Principles of reactor dynamics
- Reactor poisoning
- The Idaho and Chernobyl accidents
- Principles of the nuclear fuel cycle
- Reprocessing of irradiated fuel elements and vitrification of fission product solutions
- Interim storage of nuclear residues in surface facilities
- Multi barrier concepts for final disposal in deep geological formations
- The situation in the repositories Asse II, Konrad and Morsleben

Workload
Regular attendance: 14 h
self study 46 h

Literature
AEA- Open documentation of the reactor accidents
K. Wirtz: Basics of Reactor technic Par I, II, Technic School Karlsruhe 1966 (in German)
D. Emendorfer. K.H. Höcker: Theory of nuclear reactions, Parts I, II BI- Hochschultaschenbücher 1969 (in German)
J. Duderstadt and L. Hamilton: Nuclear reactor Analysis, J. Wiley $ Sons , Inc. 1975.
R.C. Ewing: The nuclear fuel cycle: a role for mineralogy and geochemistry. Elements vol. 2, p.331-339, 2006
J. Bruno, R.C. Ewing: Spent nuclear fuel. Elements vol. 2, p.343-349, 2006

T 11.310 Course: Physical Basics of Laser Technology [T-MACH-109084]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

Type	Credits	Recurrence	Version
Completed coursework	6	Each winter term	1

Events					
WS 19/20	2181612	Physical basics of laser technology	3 SWS	Lecture / Practice (VÜ)	Schneider
Exams					
SS 2019	76-T-MACH-109084	Physical Basics of Laser Technology		Prüfung (PR)	Schneider
WS 19/20	76-T-MACH-109084	Physical Basics of Laser Technology		Prüfung (PR)	Schneider

Competence Certificate
colloquium (30 min)

no tools or reference materials

Prerequisites
It is not possible, to combine this brick with brick Laser Application in Automotive Engineering [T-MACH-105164] and brick Physical Basics of Laser Technology [T-MACH-102102]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105164 - Laser in Automotive Engineering must not have been started.
2. The course T-MACH-102102 - Physical Basics of Laser Technology must not have been started.

Recommendation
basic knowledge of physics, chemistry and material science

Below you will find excerpts from events related to this course:

V Physical basics of laser technology
2181612, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

lecture notes via ILIAS

Notes
Based on the description of the physical basics about the formation and the properties of laser light the lecture goes through the different types of laser beam sources used in industry these days. The lecture focuses on the usage of lasers especially in materials engineering. Other areas like measurement technology or medical applications are also mentioned. An excursion to the laser laboratory of the Institute for Applied Materials (IAM) will be offered.

- physical basics of laser technology
- laser beam sources (solid state, diode, gas, liquid and other lasers)
- beam properties, guiding and shaping
- lasers in materials processing
- lasers in measurement technology
- lasers for medical applications
- savety aspects

The lecture is complemented by a tutorial.

The student

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of different laser sources.
- can describe the influence of laser, material and process parameters for the most important methods of laser-based materials processing and choose laser sources suitable for specific applications.
- can illustrate the possible applications of laser sources in measurement and medicine technology
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

regular attendance: 33,5 hours
self-study: 116,5 hours

The assessment consists of an oral exam (ca. 30 min) taking place at the agreed date (according to Section 4(2), 2 of the examination regulation). The re-examination is offered upon agreement.

It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

Learning Content
Based on the description of the physical basics about the formation and the properties of laser light the lecture goes through the different types of laser beam sources used in industry these days. The lecture focuses on the usage of lasers especially in materials engineering. Other areas like measurement technology or medical applications are also mentioned. An excursion to the laser laboratory of the Institute for Applied Materials (IAM) will be offered.

- physical basics of laser technology
- laser beam sources (solid state, diode, gas, liquid and other lasers)
- beam properties, guiding and shaping
- lasers in materials processing
- lasers in measurement technology
- lasers for medical applications
- savety aspects

The lecture is complemented by a tutorial.

Annotation
It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

Workload
regular attendance: 33,5 hours
self-study: 116,5 hours

Literature
W. T. Silfvast: Laser Fundamentals, 2008, Cambridge University Press

W. M. Steen: Laser Material Processing, 2010, Springer

T 11.311 Course: Physical Basics of Laser Technology [T-MACH-102102]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	5	Each winter term	3

Events					
WS 19/20	2181612	Physical basics of laser technology	3 SWS	Lecture / Practice (VÜ)	Schneider
Exams					
SS 2019	76-T-MACH-102102	Physical Basics of Laser Technology		Prüfung (PR)	Schneider
WS 19/20	76-T-MACH-102102	Physical Basics of Laser Technology		Prüfung (PR)	Schneider

Competence Certificate
oral examination (30 min)

no tools or reference materials

Prerequisites
It is not possible, to combine this brick with brick Laser Application in Automotive Engineering [T-MACH-105164] and brick Physical Basics of Laser Technology [T-MACH-109084]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105164 - Laser in Automotive Engineering must not have been started.
2. The course T-MACH-109084 - Physical Basics of Laser Technology must not have been started.

Recommendation
Basic knowledge of physics, chemistry and material science

Below you will find excerpts from events related to this course:

V Physical basics of laser technology
2181612, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

lecture notes via ILIAS

Notes

Based on the description of the physical basics about the formation and the properties of laser light the lecture goes through the different types of laser beam sources used in industry these days. The lecture focuses on the usage of lasers especially in materials engineering. Other areas like measurement technology or medical applications are also mentioned. An excursion to the laser laboratory of the Institute for Applied Materials (IAM) will be offered.

- physical basics of laser technology
- laser beam sources (solid state, diode, gas, liquid and other lasers)
- beam properties, guiding and shaping
- lasers in materials processing
- lasers in measurement technology
- lasers for medical applications
- savety aspects

The lecture is complemented by a tutorial.

The student

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of different laser sources.
- can describe the influence of laser, material and process parameters for the most important methods of laser-based materials processing and choose laser sources suitable for specific applications.
- can illustrate the possible applications of laser sources in measurement and medicine technology
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

regular attendance: 33,5 hours
self-study: 116,5 hours

The assessment consists of an oral exam (ca. 30 min) taking place at the agreed date (according to Section 4(2), 2 of the examination regulation). The re-examination is offered upon agreement.

It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

Learning Content

Based on the description of the physical basics about the formation and the properties of laser light the lecture goes through the different types of laser beam sources used in industry these days. The lecture focuses on the usage of lasers especially in materials engineering. Other areas like measurement technology or medical applications are also mentioned. An excursion to the laser laboratory of the Institute for Applied Materials (IAM) will be offered.

- physical basics of laser technology
- laser beam sources (solid state, diode, gas, liquid and other lasers)
- beam properties, guiding and shaping
- lasers in materials processing
- lasers in measurement technology
- lasers for medical applications
- savety aspects

The lecture is complemented by a tutorial.

Annotation

It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

Workload

regular attendance: 33,5 hours
self-study: 116,5 hours

Literature

W. T. Silfvast: Laser Fundamentals, 2008, Cambridge University Press

W. M. Steen: Laser Material Processing, 2010, Springer

T 11.312 Course: Physics for Engineers [T-MACH-100530]

Responsible: Prof. Dr. Martin Dienwiebel
Prof. Dr. Peter Gumbsch
Prof. Dr. Alexander Nesterov-Müller
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	1

Events					
SS 2019	2142890	Physics for Engineers	2 SWS	Lecture (V)	Weygand, Dienwiebel, Nesterov-Müller, Gumbsch
Exams					
SS 2019	76-T-MACH-100530	Physics for Engineers		Prüfung (PR)	Gumbsch, Weygand, Nesterov-Müller, Dienwiebel

Competence Certificate
written exam 90 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Physics for Engineers

2142890, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

1) Foundations of solid state physics

- Wave particle dualism
- Tunnelling
- Schrödinger equation
- H-atom

2) Electrical conductivity of solids

- solid state: periodic potentials
- Pauli Principle
- band structure
- metals, semiconductors and isolators
- p-n junction / diode

3) Optics

- quantum mechanical principles of the laser
- linear optics
- non-linear optics

Exercises (2142891, 2 SWS) are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students and for testing progress in learning of the topics.

The student

- has the basic understanding of the physical foundations to explain the relationship between the quantum mechanical principles and the optical as well as electrical properties of materials
- can describe the fundamental experiments, which allow the illustration of these principles

regular attendance: 22,5 hours (lecture) and 22,5 hours (excerises 2142891)
self-study: 97,5 hours and 49 hours (excerises 2142891)

The assessment consists of a written exam (90 minutes) (following §4(2), 1 of the examination regulation).

Learning Content

1) Foundations of solid state physics

- Wave particle dualism
- Tunnelling
- Schrödinger equation
- H-atom

2) Electrical conductivity of solids

- solid state: periodic potentials
- Pauli Principle
- band structure
- metals, semiconductors and isolators
- p-n junction / diode

3) Optics

- quantum mechanical principles of the laser
- linear optics
- non-linear optics

Exercises (2142891, 2 SWS) are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students and for testing progress in learning of the topics.

Workload

regular attendance: 22,5 hours (lecture) and 22,5 hours (excerises 2142891)
self-study: 97,5 hours and 49 hours (excerises 2142891)

Literature

- Tipler und Mosca: Physik für Wissenschaftler und Ingenieure, Elsevier, 2004
- Haken und Wolf: Atom- und Quantenphysik. Einführung in die experimentellen und theoretischen Grundlagen, 7. Aufl., Springer, 2000
- Harris, Moderne Physik, Pearson Verlag, 2013

T 11.313 Course: Planning of Assembly Systems [T-MACH-105387]

Responsible: Eberhardt Haller
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2109034	Planning of Assembly Systems (in German)	2 SWS	Block (B)	Haller

Competence Certificate
oral exam (approx. 30 min)

The exam is offered in German only!

Prerequisites
Timely pre-registration in ILIAS, since participation is limited.

Below you will find excerpts from events related to this course:

V Planning of Assembly Systems (in German)

2109034, WS 19/20, 2 SWS, Language: German, Open in study portal **Block (B)**

Notes
Content of teaching:

1. Planning guidelines
2. Vulnerability analysis
3. Planning of work systems (technical and organisational structuring principles, capacity planning, proceedence diagram, payment system)
4. Evaluation
5. Presentation

Requirements:

- Compact course (one week full-time)
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

Recommendations:

- Knowledge of Human Factors Engineering or Production Management/Industrial Engineering helpful

The students

- know planning guidelines
- know vulnerability analysis
- are able to plan work systems (e.g. technical or organisational structuring principles, capacity planinng, proceedence diagram, payment system)
- are able to evaluate a planning solution
- are able to present results

Learning Content

1. Planning guidelines
2. Vulnerability analysis
3. Planning of work systems (technical and organisational structuring principles, capacity planning, proceedence diagram, payment system)
4. Evaluation
5. Presentation

Workload
Compact course (one week full-time).

The amount of work accounts for 120 h (=4 ECTS).

Literature
Handout and literature online ILIAS.

T 11.314 Course: Plasticity of metals and intermetallics [T-MACH-110268]

Responsible: Dr.-Ing. Alexander Kauffmann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2173648	Plasticity in metals and intermetallics	3 SWS	Lecture (V)	Kauffmann

Competence Certificate
oral exam (about 25 minutes)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Plasticity in metals and intermetallics

Lecture (V)

2173648, WS 19/20, 3 SWS, Language: German, Open in study portal

Description
The students know the macroscopic, mesoscopic and microscopic fundamentals of plasticity in metals and alloys including their qualitative and quantitative description. Furthermore, the students are able to assess the influence of these mechanisms on the respective properties of materials. The students can describe the control of the mechanisms and properties.

Notes
The students know the macroscopic, mesoscopic and microscopic fundamentals of plasticity in metals and alloys including their qualitative and quantitative description. Furthermore, the students are able to assess the influence of these mechanisms on the respective properties of materials. The students can describe the control of the mechanisms and properties.

topics:

(i) relevance of plasticity in metals and intermetallics

(ii) macroscopic features of plasticity

(iii) repetition of fundamentals for the lecture
- elasticity
- strength and hardening
- crystallography
- defects in solids

(iv) dislocations:
- fundamental concept
- observation of dislocations
- properties of dislocations
- dislocations in fcc metals
- dislocations in bcc metals
- dislocations in hcp metals and complex intermetallics

(v) single crystal plasticity
- influence of temperature, orientation, strain rate, etc. (fcc metals)
- further examples

(vi) strength of crystalline materials
- temperature dependence
- Peierls stress
- impact of solute atoms
- impact of grain boundaries
- impact of precipitates and dispersoids

(vii) other mechanisms of plasticity
- deformation twinning
- martensitic transformation
- grain boundary sliding

(viii) summary

learning objectives:
The students know the macroscopic, mesoscopic and microscopic fundamentals of plasticity in metals and alloys including their qualitative and quantitative description. Furthermore, the students are able to assess the influence of these mechanisms on the respective properties of materials. The students can describe the control of the mechanisms and properties.
requirements:
Materials Science and Engineering I/II, Materials Physics/Metals
workload:

lecture: 42 h
private studies: 78 h

Learning Content
(i) relevance of plasticity in metals and intermetallics

(ii) macroscopic features of plasticity

(iii) repetition of fundamentals for the lecture
- elasticity
- strength and hardening
- crystallography
- defects in solids

(iv) dislocations:
- fundamental concept
- observation of dislocations
- properties of dislocations
- dislocations in fcc metals
- dislocations in bcc metals
- dislocations in hcp metals and complex intermetallics

(v) single crystal plasticity
- influence of temperature, orientation, strain rate, etc. (fcc metals)
- further examples

(vi) strength of crystalline materials
- temperature dependence
- Peierls stress
- impact of solute atoms
- impact of grain boundaries
- impact of precipitates and dispersoids

(vii) other mechanisms of plasticity
- deformation twinning
- martensitic transformation
- grain boundary sliding

(viii) summary

Workload
lecture: 42 h
private studies: 78 h

Literature
P. Hirth, J. Lothe: „Theory of Dislocations“, Krieger (1992)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC070938105

Hull, D. J. Bacon: „Introduction to Dislocations“, Elsevier (2011)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC383083990 (Kapitel frei zugänglich über KIT-Lizenz abrufbar)

R.W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland (1996)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
https://www.ifw-dresden.de/institutes/imw/events/lectures/lecture-notes/physikalische-werkstoffeigenschaften/

T 11.315 Course: PLM for Product Development in Mechatronics [T-MACH-102181]

Responsible: Prof. Dr.-Ing. Martin Eigner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102613 - Major Field: Lifecycle Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2122376	PLM for product development in mechatronics	SWS	Lecture (V)	Eigner
WS 19/20	2122376	PLM for product development in mechatronics	SWS	Lecture (V)	Eigner
Exams					
SS 2019	76-T-MACH-102181	PLM for Product Development in Mechatronics		Prüfung (PR)	Eigner

Competence Certificate
Oral examination 20 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V PLM for product development in mechatronics
2122376, SS 2019, SWS, Language: German, Open in study portal

Lecture (V)

Workload
The total workload for this course is approximately 120 hours. For further information see German version.

V PLM for product development in mechatronics
2122376, WS 19/20, SWS, Language: German, Open in study portal

Lecture (V)

Workload
The total workload for this course is approximately 120 hours. For further information see German version.

T 11.316 Course: PLM in the Manufacturing Industry [T-MACH-105340]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Competence Certificate
oral exam, 20 min.

Prerequisites
None

T 11.317 Course: Plug-and-play material handling [T-MACH-106693]

Responsible: Jonathan Dziedzitz
Prof. Dr.-Ing. Kai Furmans

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	2

Events					
WS 19/20	2117070	Plug-and-play material handling	2 SWS	Practical course (P)	Furmans, Dziedzitz
Exams					
SS 2019	76-T-MACH-106693	Plug-and-play material handling		Prüfung (PR)	Furmans

Competence Certificate
Presentation of the four steps of the course content (design, implementation, test concept and evaluation)

Prerequisites
None

T 11.318 Course: Polymer Engineering I [T-MACH-102137]

Responsible: Prof. Dr.-Ing. Peter Elsner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102632 - Major Field: Polymer Engineering
M-MACH-102637 - Major Field: Tribology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2173590	Polymer Engineering I	2 SWS	Lecture (V)	Elsner, Liebig
Exams					
SS 2019	76-T-MACH-102137	Polymer Engineering I		Prüfung (PR)	Elsner
WS 19/20	76-T-MACH-102137	Polymer Engineering I		Prüfung (PR)	Elsner

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Polymer Engineering I
Lecture (V)
2173590, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
1. Economical aspects of polymers
2. Introductiom of mechanical,
chemical end electrical properties
3. Processing of polymers
(introduction)
4. Material science of polymers
5. Synthesis

learning objectives:

The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, to equip the students with knowledge and technical skills, and to use the material "polymer" meeting its requirements in an economical and ecological way.

The students

- are able to describe and classify polymers
  based on the fundamental synthesis processing techniques
- can find practical applications for state-of-the-art polymers and manufacturing technologies
- are able to apply the processing techniques, the application of polymers and polymer composites regarding to the basic principles of material science
- can describe the special mechanical, chemical and elctrical prooperties of polymers and correlate these properties to the chemical bindings.
- can define application areas and the limitation in the use of polymers

requirements:
none

workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content
1. Economical aspects of polymers
2. Introductiom of mechanical,
chemical end electrical properties
3. Processing of polymers
(introduction)
4. Material science of polymers
5. Synthesis

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature
Recommended literature and selected official lecture notes are provided in the lecture

T 11.319 Course: Polymer Engineering II [T-MACH-102138]

Responsible: Prof. Dr.-Ing. Peter Elsner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102632 - Major Field: Polymer Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2174596	Polymer Engineering II	2 SWS	Lecture (V)	Elsner
Exams					
SS 2019	76-T-MACH-102138	Polymerengineering II		Prüfung (PR)	Elsner
WS 19/20	76-T-MACH-102138	Polymerengineering II		Prüfung (PR)	Elsner

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Recommendation
Knowledge in Polymerengineering I

Below you will find excerpts from events related to this course:

V Polymer Engineering II
Lecture (V)
2174596, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
1. Processing of polymers
2. Properties of polymer components
Based on practical examples and components
2.1 Selection of material
2.2 Component design
2.3 Tool engineering
2.4 Production technology
2.5 Surface engineering
2.6 Sustainability, recycling

learning objectives:

The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, that the students gather knowledge and technical skills to use the material "polymer" meeting its requirements in an economical and ecological way.

The students

- can describe and classify different processing techniques
  and can exemplify mould design principles based on technical parts.
- know about practical applications and processing of polymer parts
- are able to design polymer parts according to given restrictions
- can choose appropriate polymers based on the technical requirements
- can decide how to use polymers regarding the production, economical and ecological requirements

requirements:
Polymerengineering I
workload:

The workload for the lecture Polymerengineering II is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Learning Content
1. Processing of polymers
2. Properties of polymer components
Based on practical examples and components
2.1 Selection of material
2.2 Component design
2.3 Tool engineering
2.4 Production technology
2.5 Surface engineering
2.6 Sustainability, recycling

Workload
The workload for the lecture Polymerengineering II is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Literature
Recommended literature and selected official lecture notes are provided in the lecture.

T 11.320 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2141853	Polymers in MEMS A: Chemistry, Synthesis and Applications	2 SWS		Rapp

Competence Certificate
Oral examination

Prerequisites
none

Below you will find excerpts from events related to this course:

V Polymers in MEMS A: Chemistry, Synthesis and Applications
2141853, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:
The lecture slides will be given out as scriptum during each lecture course.

Learning Content

We all come in contact with numerous polymeric products in everyday life. From water bottles to packaging to the cover of the iPad, many things are made of polymers. Polymers are also important materials for modern microelectromechanical systems (MEMS) allowing cost effective mass market compatible products, e.g., in the life sciences or diagnostics. But polymers are not just cost-effective replacements for more expensive classical materials in MEMS (such as, e.g., silicon) – some polymers have intrinsic properties that make them ideal materials for sensors, actuators or templates for biology and chemistry in MEMS.

This lecture will introduce the basics of organic chemistry required for understanding what polymers are, how they are manufactured and which mechanisms are responsible for their unique properties. The lecture will highlight (in the context of MEMS but also in a wider scope) where and why polymers are applied with a strong focus on their chemical and physical properties (and on their synthesis).

Some of the topics covered are:

- What is the basic chemistry of polymers? What are monomers, what are macromolecules and how are they formed?
- How are polymers produced on industrial scale – but also on the laboratory scale? Numerous examples of how to make (commonly and lesser known) polymers will be discussed including materials such as Plexiglas.
- Why are polymers so important for biochemistry and tissue engineering?
- How do photoresists work and why do some polymers contract when exposed to light?
- What are high-performance polymers and why do they have such a wide application range, e.g., in implants?
- What polymers fuel the household 3D printing community and what materials do 3D printers such as, e.g., the RepRap work with?
- How does 3D printing and rapid prototyping work and which polymers can be employed for which techniques?
- Why does silicone always smell like vinegar and why is this material so important for modern day microfluidics? How do you built fluid-logic devices using silicone?
- How do shape memory polymers remember their shape?
- What are polymer foams and why are they not only important for heat insulation but also for organic chemistry?
- How do glues work? Why are there two-component glues, what is superglue and how can you make glue from potatoes?

The lecture will be given in German language unless non-German speaking students attend. In this case, the lecture will be given in English (with some German translations of technical vocabulary). The lecture slides are in English language and will be handed out for taking notes. Additional literature is not required.

For further details, please contact the lecturer, Dr. Ing. Bastian E. Rapp (bastian.rapp@kit.edu). Preregistration is not necessary.

The examination will be held in oral form at the end of the lecture. The lecture can be chosen as "Nebenfach" or part of a "Hauptfach". The second lecture of the lecture series "Polymers in MEMS B – Physics, manufacturing and applications" (which is also held in winter semester) can be combined with this lecture as part of a "Hauptfach". In summer semester, the third part of the lecture series "Polymers in MEMS C – Biopolymers, Biopolymers and applications" will be given which may be combined with lectures A and B to form a complete "Hauptfach".

Annotation

For further details, please contact the lecturer, Dr. Ing. Bastian E. Rapp (bastian.rapp@kit.edu). Preregistration is not necessary.

Workload

- lecture: 15 * 1.5 h (22 h)
- lecture preparation (before and after lecture): 15 * 2 h (30 h)
- preparation of final exam: 70 h

T 11.321 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2141854	Polymers in MEMS B: Physics, Microstructuring and Applications	2 SWS	Lecture (V)	Worgull
Exams					
SS 2019	76-T-MACH-102191	Polymers in MEMS B: Physics, Microstructuring and Applications		Prüfung (PR)	Worgull

Competence Certificate
Oral examination

Prerequisites
none

Below you will find excerpts from events related to this course:

V Polymers in MEMS B: Physics, Microstructuring and Applications

2141854, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:
The lecture slides will be given out as scriptum during each lecture course.

Learning Content

We all come in contact with numerous polymeric products in everyday life. From water bottles to packaging to the cover of the iPad, many things are made of polymers. Polymers are also important materials for modern microelectromechanical systems (MEMS) allowing cost effective mass market compatible products, e.g., in the life sciences or diagnostics. But polymers are not just cost-effective replacements for more expensive classical materials in MEMS (such as, e.g., silicon) – some polymers have intrinsic properties that make them ideal materials for sensors, actuators or templates for biology and chemistry in MEMS.

This lecture will introduce the basics of physics and material science required for the understanding of the mechanical behavior seen from the engineers view. Micro and nanostructuring of polymers allows the fabrication of micro parts fulfilling their tasks in mostly invisible different applications. But also the fabrication of polymer parts with functional surfaces inspired from Bionics will be presented in this lesson. The lesson will give further an overview over the polymer based structuring processes and will underline the importance by a number of applications e.g. photonic structures or Lotus-like structures.

Some of the topics covered are:

- How can polymers described from the view of engineers?
- What are the differences between polymers and metals?
- Rheology of polymer melts – How does polymer melts flow?
- How can polymers be formed and demolded?
- Which structuring processes (replication) processes are available?
- How does stress influence molded parts (e.g. the deformation of a CD in a hot car)
- Shrinkage of polymers – which precision is achievable
- Gluing or welding – How can polymers be assembled?
- Simulation of replication processes
- Characterization of polymers – which properties can be measured?

The lecture will be given in German language unless non-German speaking students attend. In this case, the lecture will be given in English (with some German translations of technical vocabulary). The lecture slides are in English language and will be handed out for taking notes. Additional literature is not required.

For further details, please contact the lecturer, PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

The examination will be held in oral form at the end of the lecture. The lecture can be chosen as "Nebenfach" or part of a "Hauptfach". The second lecture of the lecture series ""Polymers in MEMS A – Chemistry, synthesis and applications " (which is also held in winter semester) can be combined with this lecture as part of a "Hauptfach". In summer semester, the third part of the lecture series "Polymers in MEMS C – Biopolymers, Biopolymers and applications" will be given which may be combined with lectures A and B to form a complete "Hauptfach".

Annotation

For further details, please contact the lecturer, PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

Workload

- lecture: 15 * 1.5 h (22 h)
- lecture preparation (before and after lecture): 15 * 2 h (30 h)
- preparation of final exam: 70 h

T 11.322 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2142855	Polymers in MEMS C - Biopolymers and Bioplastics	2 SWS		Worgull, Rapp
Exams					
SS 2019	76-T-MACH-102200	Polymers in MEMS C: Biopolymers and Bioplastics		Prüfung (PR)	Worgull, Rapp

Competence Certificate
Oral examination

Prerequisites
none

Below you will find excerpts from events related to this course:

V Polymers in MEMS C - Biopolymers and Bioplastics
2142855, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content

Polymers are ubiquitous in everyday life: from packaging materials all the way to specialty products in medicine and medical engineering. Today it is difficult to find a product which does not (at least in parts) consist of polymeric materials. The question of how these materials can be improved with respect to their disposal and consumption of (natural) resources during manufacturing is often raised. Today polymers must be fully recycled in Germany and many other countries due to the fact that they do not (or only very slowly) decompose in nature. Furthermore significant reductions of crude oil consumption during synthesis are of increasing importance in order to improve the sustainability of this class of materials. With respect to disposal polymers which do not have to be disposed by combustion but rather allow natural decomposition (composting) are of increasing interest. Polymers from renewable sources are also of interest for modern microelectromechanical systems (MEMS) especially if the systems designed are intended as single-use products.

This lecture will introduce the most important classes of these so-called biopolymers and bioplastics. It will also discuss and highlight polymers which are created from naturally created analogues (e.g. via fermentation) to petrochemical polymer precursors and describe their technical processing. Numerous examples from MEMS as well as everyday life will be given.

Some of the topics covered are:

- What are biopolyurethanes and how can you produce them from castor oil?
- What are "natural glues" and how are they different from chemical glues?
- How do you make tires from natural rubbers?
- What are the two most important polymers for life on earth?
- How can you make polymers from potatoes?
- Can wood be formed by injection molding?
- How do you make buttons from milk?
- Can you play music on biopolymers?
- Where and how do you use polymers for tissue engineering?
- How can you built LEGO with DNA?

The lecture will be given in German language unless non-German speaking students attend. In this case, the lecture will be given in English (with some German translations of technical vocabulary). The lecture slides are in English language and will be handed out for taking notes. Additional literature is not required.

For further details, please contact the lecturer, Dr. Ing. Bastian E. Rapp (bastian.rapp@kit.edu) and PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

Annotation

For further details, please contact the lecturer, Dr. Ing. Bastian E. Rapp (bastian.rapp@kit.edu) and PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

Workload

- lecture: 15 * 1.5 h (22 h)
- lecture preparation (before and after lecture): 15 * 2 h (30 h)

preparation of final exam: 70 h

Literature

Additional literature is not required.

T 11.323 Course: Powertrain Systems Technology A: Automotive Systems [T-MACH-105233]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Sascha Ott

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102637 - Major Field: Tribology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2146180	Powertrain Systems Technology A: Automotive Systems	2 SWS	Lecture (V)	Albers, Ott
Exams					
SS 2019	76-T-MACH-105233	Powertrain Systems Technology A: Automotive Systems		Prüfung (PR)	Albers, Ott

Competence Certificate
written examination: 60 min duration

Prerequisites
None

Below you will find excerpts from events related to this course:

V Powertrain Systems Technology A: Automotive Systems
Lecture (V)

2146180, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
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

Recommendations for additional courses:

- Power Train Systems Technology B: Stationary Machinery

T 11.324 Course: Powertrain Systems Technology B: Stationary Machinery [T-MACH-105216]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Sascha Ott

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2145150	Powertrain Systems Technology B: Stationary Machinery	2 SWS	Lecture (V)	Albers, Ott

Competence Certificate
written examination: 60 min duration

Prerequisites
None

Below you will find excerpts from events related to this course:

V Powertrain Systems Technology B: Stationary Machinery — Lecture (V)
2145150, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Content

Students acquire the basic skills needed to develop future energy-efficient and safe drive system solutions for use in industrial environments. The course considers holistic development methods and evaluations of drive systems. The focal points can be divided into the following chapters:

- Powertrain System
- Operator System
- Environment System
- System Components
- Development Process

Recommendations:

- Powertrain Systems Technology A: Automotive Systems

T 11.325 Course: Practical Course “Tribology” [T-MACH-105813]

Responsible: Prof. Dr. Martin Dienwiebel
Dr.-Ing. Johannes Schneider

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102637 - Major Field: Tribology

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2182115	Praktikum "Tribologie"	3 SWS	Practical course (P)	Schneider, Dienwiebel
Exams					
SS 2019	76-T-MACH-105813	Praktikum "Tribologie"		Prüfung (PR)	Schneider, Dienwiebel
WS 19/20	76-T-MACH-105813	Praktikum "Tribologie"		Prüfung (PR)	Schneider, Dienwiebel

Competence Certificate
The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Prerequisites
none

Recommendation
The attendance to one of the course Tribology (2181114) is strongly recommended!

Below you will find excerpts from events related to this course:

V Praktikum "Tribologie"

2182115, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Notes
The laboratory compromises five full-day experiments, which address the following topics:

- tribological system analysis
- basics of tribological measurement techniques
- topographical surface characterization
- tribological model tests under sliding, rolling and abrasive conditions
- microscopical characterization of worn surfaces

The student

- knows the most common methods of friction and wear measurement
- knows the most common tribological model tests for the characterization of materials under sliding, rolling and abrasive conditions
- can carry out a tribological system analysis and based on that derive suitable loading parameters for model tests

The attendance to one of the course Tribology (2181114) is strongly recommended.

regular attendance: 35 hours

self-study: 85 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Learning Content

The laboratory compromises five full-day experiments, which address the following topics:

- tribological system analysis
- basics of tribological measurement techniques
- topographical surface characterization
- tribological model tests under sliding, rolling and abrasive conditions
- microscopical characterization of worn surfaces

Annotation

The maximum number of students is 12.

Workload

regular attendance: 35 hours

self-study: 85 hours

Literature

H. Czichos, K.-H. Habig: Tribologie-Handbuch. Vieweg + Teubner Verlag, Wiesbaden, 2010 (http://www.springerlink.com/content/nl4kn1/?MUD=MP)

K. Sommer, R. Heinz, J. Schöfer: Verschleiß metallischer Werkstoffe: Erscheinungsformen sicher beurteilen. Vieweg + Teubner Verlag, Wiesbaden, 2010 (http://www.springerlink.com/content/u24843/#section=806215&page=1)

Gesellschaft für Tribologie e.V. (GFT): Arbeitsblatt 7: Tribologie – Verschleiß, Reibung: Definitionen, Begriffe, Prüfung. GFT, Moers, 2002. (Download unterwww.gft-ev.de/arbeitsblaetter.htm)

K.-H. Zum Gahr: Microstructure and wear of materials. Elsevier, Amsterdam, 1987.

11.326 Course: Practical Course Polymers in MEMS [T-MACH-105556]

Responsible: Dr.-Ing. Bastian Rapp
Dr.Ing. Matthias Worgull

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Completed coursework	2	Each summer term	1

Events					
SS 2019	2142856	Practical Course Polymers in MEMS	2 SWS	Block (B)	Worgull, Rapp

Competence Certificate
The practical course will close with an oral examination.There will be only passed and failed results, no grades.

Prerequisites
none

Below you will find excerpts from events related to this course:

Practical Course Polymers in MEMS
2142856, SS 2019, 2 SWS, Language: German, Open in study portal

Block (B)

Description
Media:
descriptions of the experiments

Learning Content
This practical course complements the lectures "Polymers in MEMS A", "Polymers in MEMS B" and "Polymers in MEMS C" and will allow students to gain a deeper understanding of polymers and their processing. During the course of this practical course, various polymers will be synthesized and molded into components suitable for microelectromechanical systems (MEMS) applications. The aim of the course is to bring a polymer all the way from synthesis to application.
The practical course will be given in German language unless non-German speaking students attend. In this case, the course will be given in English (with some German translations of technical vocabulary). Lecture notes for the experiments are in English language and will be handed out to the students. The practical course will be held "en block" at the end of the semester (presumably beginning of October)

For further details, please contact the lecturer, Dr. Ing. Bastian E. Rapp (bastian.rapp@kit.edu) and PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is mandatory. The number of participants is limited to 5 students.

Workload

- practical course: 3 * 8 h (24 h)
- experiment preparation (before and after lecture): 30 h

preparation of final exam: 66 h

Literature
Scripts of the corresponding lectures, further literature as named there.

T 11.327 Course: Practical Course Technical Ceramics [T-MACH-105178]

Responsible: Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

Type	Credits	Recurrence	Version
Completed coursework	1	Each winter term	1

Events					
WS 19/20	2125751	Practical Course Technical Ceramics	2 SWS	Practical course (P)	Schell
Exams					
WS 19/20	76-T-MACH-105178	Practical Course Technical Ceramics		Prüfung (PR)	Schell

Competence Certificate
Colloquium and laboratory report for the respective experiments.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Practical Course Technical Ceramics
2125751, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
Based on alumina as a model material, major test methods for the characterization of raw materials, intermediate and final products are practically applied. Topics:

- powder caracterization
- Shaping of powder compacts
- sintering
- microstructural characterization
- mechanical testing

On the basis of short descriptions of the methods, the students prepare themselfes, carry out the experiments and write a laboratory report.

Workload
regular attendance: 30 hours
self-study: 90 hours

Literature
Salmang, H.: Keramik, 7. Aufl., Springer Berlin Heidelberg, 2007. - Online-Ressource

Richerson, D. R.: Modern Ceramic Engineering, CRC Taylor & Francis, 2006

T 11.328 Course: Practical Training in Basics of Microsystem Technology [T-MACH-102164]

Responsible: Dr. Arndt Last
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102615 - Major Field: Medical Technology
M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Examination of another type	4	Each term	1

Events					
SS 2019	2143875	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course (P)	Last
SS 2019	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course (P)	Last
WS 19/20	2143875	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course (P)	Last
WS 19/20	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course (P)	Last
Exams					
SS 2019	76-T-MACH-102164	Practical Training in Basics of Microsystem Technology		Prüfung (PR)	Last

Competence Certificate
The assessment consists of a written exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Introduction to Microsystem Technology - Practical Course
2143875, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy

Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Workload
Time of attendance: 21 h + 2 h exam
Privat studies: 5 h preparing experiments + 10 h preparing the exam

V **Introduction to Microsystem Technology - Practical Course** **Practical course (P)**
2143877, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy
Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Workload
Time of attendance: 21 h + 2 h exam
Privat studies: 5 h preparing experiments + 10 h preparing the exam

V **Introduction to Microsystem Technology - Practical Course** **Practical course (P)**
2143875, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy
Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Workload
Time of attendance: 21 h + 2 h exam
Privat studies: 5 h preparing experiments + 10 h preparing the exam

V **Introduction to Microsystem Technology - Practical Course** **Practical course (P)**
2143877, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy
Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Workload
Time of attendance: 21 h + 2 h exam
Privat studies: 5 h preparing experiments + 10 h preparing the exam

T 11.329 Course: Practical Training in Measurement of Vibrations [T-MACH-105373]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102614 - Major Field: Mechatronics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2162208	Schwingungstechnisches Praktikum	SWS	Practical course (P)	Fidlin, Aramendiz Fuentes
Exams					
SS 2019	7600020	Practical Training in Measurement of Vibrations		Prüfung (PR)	Fidlin

Competence Certificate
Colloquium to each session, 10 out of 10 colloquiums must be passed

Prerequisites
Can not be combined with Experimental Dynamics (T-MACH-105514).

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105514 - Experimental Dynamics must not have been started.

Recommendation
Vibration Theory, Mathematical Methods of Vibration Theory, Dynamic Stability, Nonlinear Vibrations

T 11.330 Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

Responsible: Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2193010	Basic principles of powder metallurgical and ceramic processing	2 SWS	Lecture (V)	Schell
Exams					
SS 2019	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing		Prüfung (PR)	Schell
WS 19/20	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing		Prüfung (PR)	Schell

Competence Certificate
The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Basic principles of powder metallurgical and ceramic processing

Lecture (V)

2193010, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
The course covers fundamentals of the process technology for shaping of ceramic or metal particle systems. Important shaping methods are reviewed. The focus is on characterization and properties of particulate systems, and, in particular, on process technology for shaping of powders, pastes, and suspensions.

Workload
regular attendance: 25 hours
self-study: 95 hours

Literature

- R.J. Brook: Processing of Ceramics I+II, VCH Weinheim, 1996
- M.N. Rahaman: Cermamic Processing and Sintering, 2nd Ed., Marcel Dekker, 2003
- W. Schatt ; K.-P. Wieters ; B. Kieback. ".Pulvermetallurgie: Technologien und Werkstoffe", Springer, 2007
- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
- F. Thümmler, R. Oberacker. "Introduction to Powder Metallurgy", Institute of Materials, 1993

T 11.331 Course: Principles of Medicine for Engineers [T-MACH-105235]

Responsible: Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2105992	Principles of Medicine for Engineers	2 SWS	Lecture (V)	Pylatiuk
Exams					
SS 2019	76-T-MACH-105235	Principles of Medicine for Engineers		Prüfung (PR)	Pylatiuk

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Principles of Medicine for Engineers — Lecture (V)
2105992, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Content:

- Introduction: Definitions of "health" and "disease". History of medicine and paradigm shift towards evidence based medicine and personalized medicine.
- Special topics: nervous system, saltatory conduction, musculoskeletal system, cardio-circulatory system, narcosis, pain, respiratory system, sensory organs, gynaecology, digestive organs, surgery, nephrology, orthopaedics, immune system, genetics.

Learning objectives:

Students have fundamental knowledge about functionality and anatomy of organs within different medical disciplines. The students further know about technical methods in diagnosis and therapy, common diseases, their relevance and costs. Finally the students are able to communicate with medical doctors in a way, in which they prevent misunderstandings and achieve a more realistic idea of each others expectations.

Learning Content

- Introduction: Definitions of "health" and "disease". History of medicine and paradigm shift towards evidence based medicine and personalized medicine.
- Special topics: nervous system, saltatory conduction, musculoskeletal system, cardio-circulatory system, narcosis, pain, respiratory system, sensory organs, gynaecology, digestive organs, surgery, nephrology, orthopaedics, immune system, genetics.

Annotation
Recommendations: Organ support systems

Workload
General attendance: 21 h

Self-study: 99 h

Literature

- Adolf Faller, Michael Schünke: Der Körper des Menschen. Thieme Verlag.
- Renate Huch, Klaus D. Jürgens: Mensch Körper Krankheit. Elsevier Verlag.

T 11.332 Course: Probability Theory and Statistics [T-MATH-109620]

Responsible: Prof. Dr. Daniel Hug
Organisation: KIT Department of Mathematics
Part of: M-MACH-102594 - Mathematical Methods
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	6	Each term	2

Exams				
SS 2019	7700012	Probability Theory and Statistics	Prüfung (PR)	Winter

Competence Certificate
Written exam (90 min.)

Prerequisites
None

11.333 Course: Process Simulation in Forming Operations [T-MACH-105348]

Responsible: Dr.-Ing. Dirk Helm
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102646 - Major Field: Applied Mechanics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2161501	Process Simulation in Forming Operations	2 SWS	Lecture (V)	Helm

Competence Certificate
oral exam, 20 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

Process Simulation in Forming Operations

2161501, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Based on basics of continuum mechanics, material theory and numerics the lecture gives an introduction into the simulation of forming operations for metals

- plasticity for metallic materials: dislocations, twinning, phase transformations, aniostropy, hardening
- classification of forming operations and discussion of selected topics
- basics of tensor algebra and tensor analysis
- continuum mechanics: kinematics, finite deformations, balance laws, thermdydnamics
- material theory: basics, modelling concepts, plasticity and visco plasticity, yield functions (von Mises, Hill, ...), kinematic and isotropic hardening, damage
- thermomechanical coupling
- modelling of contact
- finite element method: explicit and implicite formulations, types of elements, numerical integration of material models
- process simulation of selected problems of sheet metal forming

Learning Content
Based on basics of continuum mechanics, material theory and numerics the lecture gives an introduction into the simulation of forming operations for metals

- plasticity for metallic materials: dislocations, twinning, phase transformations, aniostropy, hardening
- classification of forming operations and discussion of selected topics
- basics of tensor algebra and tensor analysis
- continuum mechanics: kinematics, finite deformations, balance laws, thermdydnamics
- material theory: basics, modelling concepts, plasticity and visco plasticity, yield functions (von Mises, Hill, ...), kinematic and isotropic hardening, damage
- thermomechanical coupling
- modelling of contact
- finite element method: explicit and implicite formulations, types of elements, numerical integration of material models
- process simulation of selected problems of sheet metal forming

11.334 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102618 - Major Field: Production Technology
M-MACH-102628 - Major Field: Lightweight Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2149670	Product- and Production-Concepts for modern Automobiles	2 SWS	Lecture (V)	Steegmüller, Kienzle

Competence Certificate
Oral Exam (20 min)

Prerequisites
T-MACH-105166 - Materials and Processes for Body Leightweight Construction in the Automotive Industry must not have been started.

Below you will find excerpts from events related to this course:

V Product- and Production-Concepts for modern Automobiles

Lecture (V)

2149670, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

The lecture illuminates the practical challenges of modern automotive engineering. As former leaders of the automotive industry, the lecturers refer to current aspects of automotive product development and production.

The aim is to provide students with an overview of technological trends in the automotive industry. In this context, the course also focuses on changes in requirements due to new vehicle concepts, which may be caused by increased demands for individualisation, digitisation and sustainability. The challenges that arise in this context will be examined from both a production technology and product development perspective and will be illustrated with practical examples thanks to the many years of industrial experience of both lecturers.

The topics covered are:

- General conditions for vehicle and body development
- Integration of new drive technologies
- Functional requirements (crash safety etc.), also for electric vehicles
- Development Process at the Interface Product & Production, CAE/Simulation
- Energy storage and supply infrastructure
- Aluminium and lightweight steel construction
- FRP and hybrid parts
- Battery, fuel cell and electric motor production
- Joining technology in modern car bodies
- Modern factories and production processes, Industry 4.0.

Learning Outcomes:

The students ...

- are able to name the presented general conditions of vehicle development and are able to discuss their influences on the final product using practical examples.
- are able to name the various lightweight approaches and identify possible areas of application.
- are able to identify the different production processes for manufacturing lightweight structures and explain their functions.
- are able to perform a process selection based on the methods and their characteristics.

Workload:

regular attendance: 25 hours
self-study: 95 hours

Learning Content

The lecture illuminates the practical challenges of modern automotive engineering. As former leaders of the automotive industry, the lecturers refer to current aspects of automotive product development and production.

The aim is to provide students with an overview of technological trends in the automotive industry. In this context, the course also focuses on changes in requirements due to new vehicle concepts, which may be caused by increased demands for individualisation, digitisation and sustainability. The challenges that arise in this context will be examined from both a production technology and product development perspective and will be illustrated with practical examples thanks to the many years of industrial experience of both lecturers.

The topics covered are:

- General conditions for vehicle and body development
- Integration of new drive technologies
- Functional requirements (crash safety etc.), also for electric vehicles
- Development Process at the Interface Product & Production, CAE/Simulation
- Energy storage and supply infrastructure
- Aluminium and lightweight steel construction
- FRP and hybrid parts
- Battery, fuel cell and electric motor production
- Joining technology in modern car bodies
- Modern factories and production processes, Industry 4.0.

Workload

regular attendance: 25 hours
self-study: 95 hours

T 11.335 Course: Product Development - Dimensioning of Components [T-MACH-105383]

Responsible: Dr.-Ing. Stefan Dietrich
Prof. Dr.-Ing. Volker Schulze

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102593 - Product Development - Dimensioning of Components

Type	Credits	Recurrence	Version
Written examination	7	Each summer term	1

Events					
SS 2019	2150511	Product Development - Component Dimensioning	3 / 1 SWS	Lecture / Practice (VÜ)	Schulze, Dietrich
Exams					
SS 2019	76-T-MACH-105383	Product Development - Dimensioning of Components		Prüfung (PR)	Schulze

Competence Certificate
written exam (2 hours)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Product Development - Component Dimensioning

2150511, SS 2019, 3 / 1 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes
The aim of the lecture is to present the topics of the dimensioning and the material science in their connection and to learn how to deal with corresponding methods and the combination thereof.

For the prospective engineer the most important educational objective is to understand the interaction of these topics while the interplay of the individual material stresses in the component are clarified.

The topics in detail are

Structural dimensioning: basic stresses, superimposed stresses, notch influence, fatigue limit, fatigue strength, assessment of cracked components, operational strength, residual stresses, high temperature stress and corrosion

Material selection: Basics, material indices, material selection diagrams, Ashby procedure, multiple boundary conditions, target conflicts, shape and efficiency.

Learning target: The students...

are capable to design and dimension components according to their load.

can include mechanical material properties from the mechanical material test in the dimensioning process.

can identify superimposed total loads and critical loads on simple components and to compute them.

acquire the skill to select materials based on the application area of the components and respective loads.

Examination: written exam (2 hours)

Learning Content

The aim of the lecture is to present the topics of the dimensioning and the material science in their connection and to learn how to deal with corresponding methods and the combination thereof.

For the prospective engineer the most important educational objective is to understand the interaction of these topics while the interplay of the individual material stresses in the component are clarified.

The topics in detail are

Structural dimensioning: basic stresses, superimposed stresses, notch influence, fatigue limit, fatigue strength, assessment of cracked components, operational strength, residual stresses, high temperature stress and corrosion

Material selection: Basics, material indices, material selection diagrams, Ashby procedure, multiple boundary conditions, target conflicts, shape and efficiency.

Learning target: The students...

are capable to design and dimension components according to their load.

can include mechanical material properties from the mechanical material test in the dimensioning process.

can identify superimposed total loads and critical loads on simple components and to compute them.

acquire the skill to select materials based on the application area of the components and respective loads.

written exam (2 hours)

learning objectives:

The students...

are capable to design and dimension components according to their load.

can include mechanical material properties from the mechanical material test in the dimensioning process.

can identify superimposed total loads and critical loads on simple components and to compute them.

acquire the skill to select materials based on the application area of the components and respective loads.

requirements:

workload:

Literature

Lecture notes

T 11.336 Course: Product Lifecycle Management [T-MACH-105147]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2121350	Product Lifecycle Management	2 SWS	Lecture (V)	Ovtcharova
Exams					
SS 2019	76-T-MACH-105147	Product Lifecycle Management		Prüfung (PR)	Ovtcharova

Competence Certificate
Writen examination 90 min.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Product Lifecycle Management
2121350, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Product Lifecycle Management (PLM) is an approach to the holistic and cross-company management and control of all product-related processes and data throughout the life cycle along the extended supply chain - from design and production to sales, to the dismantling and recycling.

Product Lifecycle Management is a comprehensive approach for effective and efficient design of the product life cycle. Based on all product information, which comes up across the entire value chain and across multiple partners, processes, methods and tools are made available to provide the right information at the right time, quality and the right place.

The course covers:

- A consistent description of all business processes that occur during the product life cycle (development, production, sales, dismantling, ...)
- the presentation of methods for the performance of the PLM business processes,
- explaining the most important corporate information systems to support the life cycle (PDM, ERP, SCM, CRM systems) to sample the software manufacturer SAP

Workload
regular attendance: 42 hours
self-study: 128 hours

Literature
Lecture slides.

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 11.337 Course: Product, Process and Resource Integration in the Automotive Industry [T-MACH-102155]

Responsible: Dr.-Ing. Sama Mbang
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2123364	Product, Process and Resource Integration in the Automotive Industry	2 SWS	Lecture (V)	Mbang
Exams					
SS 2019	76-T-MACH-102155	Product, Process and Resource Integration in the Automotive Industry		Prüfung (PR)	Mbang

Competence Certificate
Oral examination 20 min.

Prerequisites
None

Annotation
Limited number of participants.

Below you will find excerpts from events related to this course:

V Product, Process and Resource Integration in the Automotive Industry — Lecture (V)

2123364, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
The lecture

- Overview of product development in the automotive sector (process- and work cycle, IT-Systems)
- Integrated product models in the automotive industry (product, process and resource)
- New CAx modeling methods (intelligent feature technology, templates & functional modeling)
- Automation and knowledge-based mechanism for product design and production planning
- Product development in accordance with defined process and requirement (3D-master principle, tolerance models)
- Concurrent Engineering, shared working
- Enhanced concepts: the digital and virtual factory (application of virtual technologies and methods in the product development)
- Systems: Siemens NX .

Additionally, A practical industrial project study is offered, which is based on an integrated application scenario (from design of production resources, over testing and validation method planning to the manufacturing and implementation of the production resources).

Since the student will be divided in small teams, this study will also teach the students about team word and distributed development.

Annotation
Max. 20 students, registration necessary (ILIAS)

Workload
regular attendance: 32 hours
self-study: 72 hours

Literature
Lecture slides

T 11.338 Course: Production and Logistics Controlling [T-WIWI-103091]

Responsible: Alexander Rausch
Organisation: KIT Department of Economics and Management
Part of: M-MACH-102629 - Major Field: Logistics and Material Flow Theory

Type	Credits	Recurrence	Version
Written examination	3	Each winter term	1

Exams				
SS 2019	79-T-WIWI-103091	Production and Logistics Controlling	Prüfung (PR)	Furmans, Mittwollen

Competence Certificate
The assessment consists of a written exam (60 minutes) following §4(2), 1 of the examination regulation.
The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
None

T 11.339 Course: Production Planning and Control [T-MACH-105470]

Responsible: Dr.-Ing. Andreas Rinn
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2110032	Production Planning and Control	2 SWS		Rinn

Competence Certificate
written exam 60 minutes (if the number of participants is low, the examination is oral, 20 minutes)

Prerequisites
Timely pre-registration in ILIAS, since participation is limited.

Below you will find excerpts from events related to this course:

V Production Planning and Control
2110032, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

1. Goals and recommanditions for production planning and control
2. Strategies for work control
3. Case study: Manufacturing of bicycles
4. FASI-Plus: Simulation of a bicycle factory for the production planning and control
5. Simulation of the order processing
6. Decision making about order control and procurement of purchased parts
7. Evaluation of the simulation protocols
8. Realisation of production planning and control

Requirements:

- Compact course
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

Recommendations:

- Knowledge in Production Management/Industrial Engineering is required
- Knowledge of Work Science and Economics is helpful
- Knowledge of Informatics is not required, but helpful

Learning targets:

- Lerninhalte zum Thema "Produktionsmanagement" vertiefen
- Kenntnisse über die Produktionsplanung und -steuerung erweitern
- Grundlegende Techniken der Modellierung und Simulation von Produktionssystemen verstehen

Learning Content

1. Goals and recommanditions for production planning and control
2. Strategies for work control
3. Case study: Manufacturing of bicycles
4. FASI-Plus: Simulation of a bicycle factory for the production planning and control
5. Simulation of the order processing
6. Decision making about order control and procurement of purchased parts
7. Evaluation of the simulation protocols
8. Realisation of production planning and control

Workload

Compact course.

The amount of work accounts for 120 h (=4 ECTS).

Literature

Handout and literature are available on ILIAS for download.

T 11.340 Course: Production Techniques Laboratory [T-MACH-105346]

Responsible: Prof. Dr.-Ing. Barbara Deml
Prof. Dr.-Ing. Jürgen Fleischer
Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Jivka Ovtcharova

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102618 - Major Field: Production Technology
M-MACH-102629 - Major Field: Logistics and Material Flow Theory

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	3

Events					
SS 2019	2110678	Production Techniques Laboratory	4 SWS	Practical course (P)	Deml, Fleischer, Furmans, Ovtcharova
Exams					
SS 2019	76-T-MACH-105346	Production Techniques Laboratory		Prüfung (PR)	Deml, Furmans, Ovtcharova, Schulze

Competence Certificate
Advanced Internship: Participate in practicle exercise courses and complete the colloquia successfully.

Elective Subject: Participate in practicle exercise courses and complete the colloquia successfully and presentation of a specific topic.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Production Techniques Laboratory

2110678, SS 2019, 4 SWS, Language: German, Open in study portal

Practical course (P)

Description
Media:

several

Notes
The production technique laboratory (PTL) is a collaboration of the institutes wbk, IFL, IMI and ifab.

1. Computer Aided Product Development (IMI)
2. Computer communication in factory (IMI)
3. Production of parts with CNC turning machines (wbk)
4. Controlling of production systems using PLCs (wbk)
5. Automated assembly systems (wbk)
6. Optical identification in production and logistics (IFL)
7. RFID identification systems (IFL)
8. Storage and order-picking systems (IFL)
9. Production Management (ifab)
10. Time study (ifab)
11. Accomplishment of workplace design (ifab)

Recommendations:

Participation in the following lectures:

- Informationssystems in logistics and supply chain management
- Material flow in logistic systems
- Manufacturing technology
- Human Factors Engineering

Learning Objects:

The students acquire in the lab profound knowledge about the scientific theories, principles and methods of Production Engineering. Afterwards they are able to evaluate and design complex production systems according to problems of manufacturing and process technologies, materials handling, handling techniques, information engineering as well as production organisation and management.

After completion this lab, the students are able

- to analyse and solve planning and layout problems of the discussed fields,
- to evaluate and configure the quality and efficiency of production, processes and products,
- to plan, control and evaluate the production of a production enterprise,
- to configure and evaluate the IT architecture of a production enterprise,
- to design and evaluate appropriate techniques for conveying, handling and picking within a production system,
- to design and evaluate the part production and the assembly by considering the work processes and the work places.

Learning Content
The production technique laboratory (PTL) is a collaboration of the institutes wbk, IFL, IMI and ifab.

1. Computer Aided Product Development (IMI)
2. Computer communication in factory (IMI)
3. Production of parts with CNC turning machines (wbk)
4. Controlling of production systems using PLCs (wbk)
5. Automated assembly systems (wbk)
6. Optical identification in production and logistics (IFL)
7. RFID identification systems (IFL)
8. Storage and order-picking systems (IFL)
9. Production Management (ifab)
10. Time study (ifab)
11. Accomplishment of workplace design (ifab)

Annotation
none

Workload
The amount of work is 120 h (=4 ECTS).

Literature
Handouts and literature references are available online on ILIAS.

11.341 Course: Productivity Management in Production Systems [T-MACH-105523]

Responsible: Prof. Dr. Sascha Stowasser
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102618 - Major Field: Production Technology
M-MACH-102629 - Major Field: Logistics and Material Flow Theory

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2110046	Productivity Management in Production Systems	4 SWS		Stowasser
Exams					
SS 2019	76-T-MACH-105523	Productivity Management in Production Systems		Prüfung (PR)	Deml

Competence Certificate
oral exam (approx. 30 min)

The exam is offered in German only!

Prerequisites
none

Below you will find excerpts from events related to this course:

Productivity Management in Production Systems
2110046, SS 2019, 4 SWS, Language: German, Open in study portal

Description
Media:

Powerpoint, movies, exercises

Notes

1. Definition and terminology of process design and industrial engineering
2. Tasks of industrial engineering
3. Actual approaches of organisation of production (Holistic production systems, Guided group work et al.)
4. Methods and principles of industrial engineering and production systems
5. Case studies and exercises for process design
6. Industry 4.0

Requirements:

- Compact course (one week full-time)
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

Recommendations:

- Knowledge of work science is helpful

Learning objective:

- Ability to design work operations and processes effecitvely and efficiently
- Instruction in methods of time study (MTM, Data acquisition etc.)
- Instruction in methods and principles of process design
- The Students are able to apply methods for the design of workplaces, work operations and processes.
- The Students are able to apply actual approaches of process and production organisation.

Learning Content

1. Definition and terminology of process design and industrial engineering
2. Tasks of industrial engineering
3. Actual approaches of organisation of production (Holistic production systems, Guided group work et al.)
4. Methods and principles of industrial engineering and production systems
5. Case studies and exercises for process design
6. Industry 4.0

Workload

Compact course (one week full-time).

The amount of work accounts for 120 h (=4 ECTS).

Literature

Handout and literature is available on ILIAS for download.

T 11.342 Course: Project Management in Global Product Engineering Structures [T-MACH-105347]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Peter Gutzmer
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102630 - Major Field: Mobile Machines
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2145182	Project management in Global Product Engineering Structures	2 SWS	Lecture (V)	Gutzmer

Competence Certificate
oral exam (20 min)

Aids: None

Prerequisites
none

Below you will find excerpts from events related to this course:

V Project management in Global Product Engineering Structures
Lecture (V)

2145182, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
Product development process

Coordination of product development and handling of complexity

project management

matrix organization

planning / specification / target system

interaction of development and production

Workload
regular attendance: 21 h

self-study: 99 h

Literature
lecture notes

T 11.343 Course: Project Management in Rail Industry [T-MACH-104599]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102641 - Major Field: Rail System Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2115995	Project Management in Rail Industry	2 SWS	Lecture (V)	Gratzfeld
Exams					
SS 2019	76-T-MACH-104599	Project Management in Rail Industry		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-104599	Project Management in Rail Industry		Prüfung (PR)	Gratzfeld

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Project Management in Rail Industry
2115995, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

All slides are available for download (Ilias-platform).

Notes
Rail vehicles are capital-intensive goods which are manufactured in small series (like aircraft). The work to done at industry and customers is organized in "projects". This is completely different to the way of working in large-scale production (like car industry). Everybody working in this type of business is part of a project and should be aware of the typical processes.

The lecturer provides a comprehensive overview about modern project management for small series of capital-intensive goods. The content is valid not for rail vehicle business but also for other areas with similar business processes.
The following topics will be discussed:

1. Introduction: definition of project and project management
2. Project management system: project phases, main processes and supporting processes, governance
3. Organization: organizational structure within a company, project organization, roles in a project organization
4. Main processes: project start, project plan, work brake down structure, detailed project schedule, risk and opportunity management, change management, project closure
5. Governance

Learning Content
Rail vehicles are capital-intensive goods which are manufactured in small series (like aircraft). The work to done at industry and customers is organized in "projects". This is completely different to the way of working in large-scale production (like car industry). Everybody working in this type of business is part of a project and should be aware of the typical processes.

The lecturer provides a comprehensive overview about modern project management for small series of capital-intensive goods. The content is valid not for rail vehicle business but also for other areas with similar business processes.
The following topics will be discussed:

1. Introduction: definition of project and project management
2. Project management system: project phases, main processes and supporting processes, governance
3. Organization: organizational structure within a company, project organization, roles in a project organization
4. Main processes: project start, project plan, work brake down structure, detailed project schedule, risk and opportunity management, change management, project closure
5. Governance

Annotation
None.

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
A bibliography is available for download (Ilias-platform).

T 11.344 Course: Project Mikromanufacturing: Development and Manufacturing of Microsystems [T-MACH-105457]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Examination of another type	5	Each winter term	2

Events					
WS 19/20	2149680	Project Micro-Manufacturing: Design and Manufacturing of a Microsystem	3 SWS		Schulze, Dehen
Exams					
SS 2019	76-T-MACH-105457	Project Mikromanufacturing: Development and Manufacturing of Microsystems		Prüfung (PR)	Schulze

Competence Certificate
Alternative test achievement (graded):

- presentation (about 15 min) with weighting 40%
- scientific colloquium (about 15 min) with weighting 40%
- Project work (graded) with weighting 20%

Prerequisites
None

Below you will find excerpts from events related to this course:

V Project Micro-Manufacturing: Design and Manufacturing of a Microsystem
2149680, WS 19/20, 3 SWS, Language: German, Open in study portal

Description
Media:

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

The course "Project micro manufacturing: design and manufacturing of a micro system" combines the basics of micro manufacturing with project work. The project work will be done in cooperation with an industry partner. The students learn the basics of micro milling, micro electric discharge machining, micro laser ablation, micro powder injection molding and micro quality assurance. Furthermore they get to know the CAD-CAM process chain. That is the manufacturing of a production out of a CAD model. The students develop ideas and concepts matching the given task and present the results to the industry partner. Then they create parts that are designed for manufacturability out of their concepts. Those parts are manufactured at the wbk and finally assembled to a prototype.

Learning Outcomes:

The students ...

- are able to describe the micro manufacturing processes as well as their characteristics and applications.
- can choose suitable manufacturing processes for a given product.
- are able to describe the process along the CAD-CAM process chain from scratch to manufacturing.
- can explain how the development process for a micro product looks like.
- are able to describe how design for manufacturability works for micro products and where the differences to macroscopic scale are.

Workload:

regular attendance: 31,5 hours
self-study: 148,5 hours

Learning Content

The course "Project micro manufacturing: design and manufacturing of a micro system" combines the basics of micro manufacturing with project work. The project work will be done in cooperation with an industry partner. The students learn the basics of micro milling, micro electric discharge machining, micro laser ablation, micro powder injection molding and micro quality assurance. Furthermore they get to know the CAD-CAM process chain. That is the manufacturing of a production out of a CAD model. The students develop ideas and concepts matching the given task and present the results to the industry partner. Then they create parts that are designed for manufacturability out of their concepts. Those parts are manufactured at the wbk and finally assembled to a prototype.

Workload

regluar attendance: 31,5 hours
self-study: 148,5 hours

T 11.345 Course: Project Workshop: Automotive Engineering [T-MACH-102156]

Responsible: Dr.-Ing. Michael Frey
Prof. Dr. Frank Gauterin
Dr.-Ing. Martin Gießler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each term	1

Events					
SS 2019	2115817	Project Workshop: Automotive Engineering	3 SWS	Lecture (V)	Gauterin, Gießler, Frey
WS 19/20	2115817	Project Workshop: Automotive Engineering	3 SWS	Lecture (V)	Gauterin, Gießler, Frey
Exams					
SS 2019	76-T-MACH-102156	Project Workshop: Automotive Engineering		Prüfung (PR)	Gauterin

Competence Certificate
Oral examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Project Workshop: Automotive Engineering

2115817, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.

Annotation
Selection procedure, applications are to submit in the end of the preceding semester.

Workload
regular attendance: 49 hours
self-study:131 hours

Literature
Steinle, Claus; Bruch, Heike; Lawa, Dieter (Hrsg.), Projektmanagement, Instrument moderner Innovation, FAZ Verlag, Frankfurt a. M., 2001, ISBN 978-3929368277

The scripts will be supplied in the start-up meeting.

V **Project Workshop: Automotive Engineering** **Lecture (V)**
2115817, WS 19/20, 3 SWS, Language: German, Open in study portal

Notes
Limited number of participants with selection procedure, in German language. Please send the application at the end of the previous semester
Date and room: see homepage of institute.

Learning Content
During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.

Annotation
Selection procedure, applications are to submit in the end of the preceding semester.

Workload
regular attendance: 49 hours
self-study: 131 hours

Literature
Steinle, Claus; Bruch, Heike; Lawa, Dieter (Hrsg.), Projektmanagement, Instrument moderner Innovation, FAZ Verlag, Frankfurt a. M., 2001, ISBN 978-3929368277

The scripts will be supplied in the start-up meeting.

T 11.346 Course: ProVIL - Product development in a Virtual Idea Laboratory [T-MACH-106738]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Exams				
SS 2019	76T-MACH-106738	ProVIL - Product development in a Virtual Idea Laboratory	Prüfung (PR)	Albers

Competence Certificate
colloquia and presentations.

Prerequisites
none

11.347 Course: Public Law I - Basic Principles [T-INFO-101963]

Responsible: Prof. Dr. Nikolaus Marsch
Organisation: KIT Department of Informatics
Part of: M-MACH-102596 - Compulsory Elective Subject Economics/Law

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	24016	Öffentliches Recht I - Grundlagen	2 SWS	Lecture (V)	Marsch
Exams					
SS 2019	7500100	Public Law I - Basic Principles		Prüfung (PR)	Marsch

T 11.348 Course: Quality Management [T-MACH-102107]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102596 - Compulsory Elective Subject Economics/Law
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102618 - Major Field: Production Technology
M-MACH-102640 - Major Field: Technical Logistics
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2149667	Quality Management	2 SWS	Lecture (V)	Lanza
Exams					
SS 2019	76-T-MACH-102107	Quality Management		Prüfung (PR)	Lanza

Competence Certificate
Written Exam (60 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Quality Management

2149667, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

Based on the quality philosophies Total Quality Management (TQM) and Six Sigma, the lecture deals with the requirements of modern quality management. Within this context, the process concept of a modern enterprise and the process-specific fields of application of quality assurance methods are presented. The lecture covers the current state of the art in preventive and non-preventive quality management methods in addition to manufacturing metrology, statistical methods and service related quality management. The content is completed with the presentation of certification possibilities and legal quality aspects.

Main topics of the lecture:

- The term "Quality"
- Total Quality Management (TQM) and Six Sigma
- Universal methods and tools
- QM during early product stages – product denition
- QM during product development and in procurement
- QM in production – manufacturing metrology
- QM in production – statistical methods
- QM in service
- Quality management systems
- Legal aspects of QM

Learning Outcomes:

The students ...

- are capable to comment on the content covered by the lecture.
- are capable of substantially quality philosophies.
- are able to apply the QM tools and methods they have learned about in the lecture to new problems from the context of the lecture.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about in the lecture for a specific problem.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content

Based on the quality philosophies Total Quality Management (TQM) and Six Sigma, the lecture deals with the requirements of modern quality management. Within this context, the process concept of a modern enterprise and the process-specific fields of application of quality assurance methods are presented. The lecture covers the current state of the art in preventive and non-preventive quality management methods in addition to manufacturing metrology, statistical methods and service related quality management. The content is completed with the presentation of certification possibilities and legal quality aspects.
Main topics of the lecture:

- The term "Quality"
- Total Quality Management (TQM) and Six Sigma
- Universal methods and tools
- QM during early product stages – product denition
- QM during product development and in procurement
- QM in production – manufacturing metrology
- QM in production – statistical methods
- QM in service
- Quality management systems
- Legal aspects of QM

Annotation

None

Workload

regular attendance: 21 hours
self-study: 99 hours

T 11.349 Course: Radiation Protection: Ionising Radiation [T-ETIT-100663]

Responsible: Prof. Dr. Olaf Dössel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Recurrence	Version
Oral examination	3	Each winter term	1

Prerequisites
none

T 11.350 Course: Rail System Technology [T-MACH-106424]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102641 - Major Field: Rail System Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2115919	Rail System Technology	2 SWS	Lecture (V)	Gratzfeld
WS 19/20	2115919	Rail System Technology	2 SWS	Lecture (V)	Gratzfeld
Exams					
SS 2019	76-T-MACH-106424	Rail System Technology		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-106424	Rail System Technology		Prüfung (PR)	Gratzfeld

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Rail System Technology
2115919, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

All slides are available for download (Ilias-platform).

Notes

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, power networks, filling stations
8. History (optional)

Learning Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, power networks, filling stations
8. History (optional)

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
A bibliography is available for download (Ilias-platform).

V **Rail System Technology** **Lecture (V)**
2115919, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

All slides are available for download (Ilias-platform).

Notes

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, power networks, filling stations
8. History (optional)

Learning Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signalling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, power networks, filling stations
8. History (optional)

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
A bibliography is available for download (Ilias-platform).

T 11.351 Course: Rail Vehicle Technology [T-MACH-105353]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102641 - Major Field: Rail System Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2115996	Rail Vehicle Technology	2 SWS	Lecture (V)	Gratzfeld
WS 19/20	2115996	Rail Vehicle Technology	2 SWS	Lecture (V)	Gratzfeld
Exams					
SS 2019	76-T-MACH-105353	Rail Vehicle Technology		Prüfung (PR)	Gratzfeld
SS 2019	76-T-MACH-105355	Rail Vehicle Technology		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-105353	Rail Vehicle Technology		Prüfung (PR)	Gratzfeld

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Rail Vehicle Technology
2115996, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

All slides are available for download (Ilias-platform).

Notes

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, interfaces
3. Bogies: forces, running gears, axle configuration
4. Drives: vehicle with/without contact wire, dual-mode vehicle
5. Brakes: tasks, basics, principles, blending, brake control
6. Train control management system: definitions, networks, bus systems, components, examples
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck coaches, locomotives, freight wagons

Learning Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, interfaces
3. Bogies: forces, running gears, axle configuration
4. Drives: vehicle with/without contact wire, dual-mode vehicle
5. Brakes: tasks, basics, principles, blending, brake control
6. Train control management system: definitions, networks, bus systems, components, examples
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck coaches, locomotives, freight wagons

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
A bibliography is available for download (Ilias-platform).

V Rail Vehicle Technology

2115996, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, interfaces
3. Bogies: forces, running gears, axle configuration
4. Drives: vehicle with/without contact wire, dual-mode vehicle
5. Brakes: tasks, basics, principles, blending, brake control
6. Train control management system: definitions, networks, bus systems, components, examples
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck coaches, locomotives, freight wagons

Learning Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, interfaces
3. Bogies: forces, running gears, axle configuration
4. Drives: vehicle with/without contact wire, dual-mode vehicle
5. Brakes: tasks, basics, principles, blending, brake control
6. Train control management system: definitions, networks, bus systems, components, examples
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck coaches, locomotives, freight wagons

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
A bibliography is available for download (Ilias-platform).

T 11.352 Course: Railways in the Transportation Market [T-MACH-105540]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102641 - Major Field: Rail System Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114914	Railways in the Transportation Market	2 SWS	Block (B)	Gratzfeld
Exams					
SS 2019	76-T-MACH-105540	Railways in the Transportation Market		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-105540	Railways in the Transportation Market		Prüfung (PR)	Gratzfeld

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Railways in the Transportation Market
2114914, SS 2019, 2 SWS, Language: German, Open in study portal

Block (B)

Description
Media:

All material is available for download (Ilias-platform).

Notes
The lecture gives an overview about perspective, challenges and chances of rail systems in the national and European market. Following items will be discussed:

- Introduction and basics
- Rail reform
- Overview of Deutsche Bahn
- Development of infrastructure
- Regulation of railways
- Intra- and intermodal competition
- Field of actions in transport policy
- Railways and enviroment
- Trends in the transportation market
- Future of Deutsche Bahn, DB 2020
- Integration of traffic carriers
- International passenger and freight transportation

Learning Content

The lecture gives an overview about perspective, challenges and chances of rail systems in the national and European market. Following items will be discussed:

- Introduction and basics
- Rail reform
- Overview of Deutsche Bahn
- Development of infrastructure
- Regulation of railways
- Intra- and intermodal competition
- Field of actions in transport policy
- Railways and enviroment
- Trends in the transportation market
- Future of Deutsche Bahn, DB 2020
- Integration of traffic carriers
- International passenger and freight transportation

Workload

Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature

none

T 11.353 Course: Reactor Safety I: Fundamentals [T-MACH-105405]

Responsible: Dr. Victor Hugo Sanchez-Espinoza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2189465	Reactor Safety I: Fundamentals	2 SWS	Lecture (V)	Sanchez-Espinoza
Exams					
SS 2019	76-T-MACH-105405	Reactor Safety I: Fundamentals		Prüfung (PR)	Sanchez-Espinoza, Stieglitz
WS 19/20	76-T-MACH-105405	Reactor Safety I: Fundamentals		Prüfung (PR)	Sanchez-Espinoza

Competence Certificate
oral exam about 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Reactor Safety I: Fundamentals

2189465, SS 2019, 2 SWS, Language: German/English, Open in study portal

Lecture (V)

Description
In the lecture, the fundamental principles and concepts of reactor safety are discussed. They facilitate the assessment of the safety status of nuclear power plants and the interpretation of incidents or accidents as such as Chernobyl or Fukushima. Starting with the explanations of the technical safety features of reactor systems, the safety concepts of different reactor types are discussed. The initiation and progression of incidents/accidents as well as the methods for the safety evaluation are also treated in the lecture. Discussing the Fukushima accident, the radiological risk from nuclear power plants together with the counter measures to stop severe accident and to limit the consequences will be explained. Finally, new development to increase the safety or reactors of Generation III and IV will be presented.

Notes

This lecture will be given in English, if required in German

The lecture discuss the fundamental principles and concepts of reactor safety including the methologies for safety assessment and major accidents.

In the lecture, the fundamental principles and concepts of reactor safety are discussed. They facilitate the assessment of the safety status of nuclear power plants and the interpretation of incidents or accidents as such as Chernobyl or Fukushima. Starting with the explanations of the technical safety features of reactor systems, the safety concepts of different reactor types are discussed. The initiation and progression of incidents/accidents as well as the methods for the safety evaluation are also treated in the lecture. Discussing the Fukushima accident, the radiological risk from nuclear power plants together with the counter measures to stop severe accident and to limit the consequences will be explained. Finally, new development to increase the safety or reactors of Generation III and IV will be presented.

Lecture Content:

- National and international nuclear regulations
- Fundamental principles of reactor safety
- Implementation of safety principles in nuclear power plants of generation 2
- Safety analysis and methods for safety assessment
- Nuclear events and accidents and its evaluation methods
- Discussion severe accidents e.g. the Fukushima accident
- Safety features of reactor systems of generation 3 and 4

Lernziele

Lecture Content:

- National and international nuclear regulations
- Fundamental principles of reactor safety
- Implementation of safety principles in nuclear power plants of generation 2
- Safety analysis and methods for safety assessment
- Nuclear events and accidents and its evaluation methods
- Discussion severe accidents e.g. the Fukushima accident
- Safety features of reactor systems of generation 3 and 4

Knowledge in energy technology, nuclear power plants, reactor physics, thermal hydraulic of nuclear reactors is welcomed

regular attendance: 30 h
self-study: 60 h

Zielgruppe: Students of Mechanical Engineering,

oral examination, duration approximately 30 minutes

Learning Content

Lecture Content:

- National and international nuclear regulations
- Fundamental principles of reactor safety
- Implementation of safety principles in nuclear power plants of generation 2
- Safety analysis and methods for safety assessment
- Nuclear events and accidents and its evaluation methods
- Discussion severe accidents e.g. the Fukushima accident
- Safety features of reactor systems of generation 3 and 4

Workload

regular attendance: 30 h
self-study: 60 h

Literature

- G. Kessler at al; Risks of Nuclear Energy Technology- Safety Concepts of Light Water Reactors. Springer Verlag 2014.
- B. R. Sehgal; Nuclear Safety in LWR: Severe Accident Phenomenology. Academic Press Elsevier. 2012.
- John C. Lee and Norman J. McCormick.July; Risk and Safety Analysis of Nuclear Systems. 2011
- G. Petrangeli; Nuclear Safety. Elsevier Butterworth-Heinemann. 2006
- J. N. Lillington; Light Water Reactor Safety: The Development of Advanced Models and Codes for Light Water Reactor Safety Analysis. Elsevier 1995.

T 11.354 Course: Reduction Methods for the Modeling and the Simulation of Vombustion Processes [T-MACH-105421]

Responsible: Dr. Viatcheslav Bykov
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102635 - Major Field: Engineering Thermodynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2166543	Reduction methods for the modeling and the simulation of combustion processes	2 SWS	Lecture (V)	Bykov

Competence Certificate
oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Reduction methods for the modeling and the simulation of combustion processes

Lecture (V)

2166543, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
The course will introduce the principles of model reduction of chemical kinetic models of combustion processes. The basic mathematical concepts and methods of analysis of chemical reaction mechanisms will be outlined in the context of model reduction. The detailed implementation scheme of model reduction will be introduced. The course will cover simplified and idealized models of combustion (e.g. auto-ignition, explosion, deflagration etc.), which will be analyzed and reduced. The main analytical methods and numerical tools will be presented, evaluated and illustrated by using these simple examples.

Workload
regular attendance: 21 hours

self-study: 100,0 hours

Literature
N. Peters, B. Rogg: Reduced kinetic mechanisms for aplication in combustion systems, Lecture notes in physics, 15, Springer Verlag, 1993.

11.355 Course: Reliability Engineering 1 [T-MACH-107447]

Responsible: Dr.-Ing. Alexei Konnov
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102624 - Major Field: Information Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Written examination	3	Each winter term	1

Events					
WS 19/20	2169550	Reliability Engineering 1	2 SWS	Lecture (V)	Konnov

Competence Certificate
written exam

Prerequisites
none

Below you will find excerpts from events related to this course:

Reliability Engineering 1
2169550, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
Technical background: instrumentation and control systems in power plants

Introduction to reliability theory
Introduction to probability theory
Introduction to formal logic
Introduction to statistic

Workload
regular attandance: 25 h

self-study: 65 h

Literature
Lesson script (link will be available)

Recommended books:

o Birolini, Alessandro: *Reliability Engineering Theory and Practice*

o Pham, Hoang: *Handbook of reliability engineering*

T 11.356 Course: Renewable Energy-Resources, Technologies and Economics [T-WIWI-100806]

Responsible: PD Dr. Patrick Jochem
Prof. Dr. Russell McKenna

Organisation: KIT Department of Economics and Management

Part of: M-MACH-104323 - Major Field: Innovation and Entrepreneurship

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	3

Events					
WS 19/20	2581012	Renewable Energy – Resources, Technologies and Economics	2 SWS	Lecture (V)	McKenna, Jochem
Exams					
SS 2019	7981012	Renewable Energy-Resources, Technologies and Economics		Prüfung (PR)	Fichtner

Competence Certificate
The assessment consists of a written exam (60 min., in English, answers in English or German) according to § 4 paragraph 2 Nr. 1 of the examination regulation SPO2015.

Prerequisites
None.

Below you will find excerpts from events related to this course:

V Renewable Energy – Resources, Technologies and Economics
2581012, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
1. General introduction: Motivation, Global situation
2. Basics of renewable energies: Energy balance of the earth, potential definition
3. Hydro
4. Wind
5. Solar
6. Biomass
7. Geothermal
8. Other renewable energies
9. Promotion of renewable energies
10. Interactions in systemic context
11. Excursion to the "Energieberg" in Mühlburg

Workload
The total workload for this course is approximately 105.0 hours. For further information see German version.

Literature
Elective literature:

- Kaltschmitt, M., 2006, Erneuerbare Energien : Systemtechnik, Wirtschaftlichkeit, Umweltaspekte, aktualisierte, korrigierte und ergänzte Auflage Berlin, Heidelberg : Springer-Verlag Berlin Heidelberg.
- Kaltschmitt, M., Streicher, W., Wiese, A. (eds.), 2007, Renewable Energy: Technology, Economics and Environment, Springer, Heidelberg.
- Quaschning, V., 2010, Erneuerbare Energien und Klimaschutz : Hintergründe - Techniken - Anlagenplanung – Wirtschaftlichkeit München : Hanser, Ill.2., aktualis. Aufl.
- Harvey, D., 2010, Energy and the New Reality 2: Carbon-Free Energy Supply, Eathscan, London/Washington.
- Boyle, G. (ed.), 2004, Renewable Energy: Power for a Sustainable Future, 2nd Edition, Open University Press, Oxford.

T 11.357 Course: Robotics I - Introduction to Robotics [T-INFO-108014]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102633 - Major Field: Robotics
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	1

Events					
WS 19/20	2424152	Robotics I - Introduction to Robotics	3/1 SWS	Lecture (V)	Asfour
Exams					
SS 2019	7500218	Robotik I - Einführung in die Robotik		Prüfung (PR)	Asfour
WS 19/20	7500106	Robotics I - Introduction to Robotics		Prüfung (PR)	Asfour

T 11.358 Course: Robotics II: Humanoid Robotics [T-INFO-105723]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-102615 - Major Field: Medical Technology
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	3

Events					
SS 2019	2400074	Robotics II: Humanoid Robotics	2 SWS	Lecture (V)	Asfour, Wächter
Exams					
SS 2019	7500086	Robotics II: Humanoid Robotics		Prüfung (PR)	Asfour
WS 19/20	7500211	Robotics II: Humanoid Robotics		Prüfung (PR)	Asfour

Below you will find excerpts from events related to this course:

V Robotics II: Humanoid Robotics

Lecture (V)

2400074, SS 2019, 2 SWS, Language: German/English, Open in study portal

Learning Content

The lecture presents current work in the field of humanoid robotics that deals with the implementation of complex sensorimotor and cognitive abilities. In the individual topics different methods and algorithms, their advantages and disadvantages, as well as the current state of research are discussed.

The topics addressed are: biomechanical models of the human body, biologically inspired and data-driven methods of grasping, active perception, imitation learning and programming by demonstration as well as semantic representations of sensorimotor experience

Workload

90 h

T 11.359 Course: Robotics III - Sensors in Robotics [T-INFO-101352]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-102609 - Major Field: Cognitive Technical Systems
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	1

Events					
SS 2019	2400067	Robotics III - Sensors and Perception in Robotics	2 SWS	Lecture (V)	Asfour, Grotz
Exams					
SS 2019	7500242	Robotics III - Sensors and Perception in Robotics		Prüfung (PR)	Asfour
WS 19/20	7500207	Robotics III - Sensors in Robotics		Prüfung (PR)	Asfour

Below you will find excerpts from events related to this course:

V Robotics III - Sensors and Perception in Robotics

2400067, SS 2019, 2 SWS, Language: German/English, Open in study portal

Lecture (V)

Learning Content

The lecture supplements the lecture Robotics I with a broad overview of sensors used in robotics. The lecture focuses on visual perception, object recognition, simultaneous localization and mapping (SLAM) and semantic scene interpretation. The lecture is divided into two parts:

In the first part a comprehensive overview of current sensor technologies is given. A basic distinction is made between sensors for the perception of the environment (exteroceptive) and sensors for the perception of the internal state (proprioceptive).

The second part of the lecture concentrates on the use of exteroceptive sensors in robotics. The topics covered include tactile exploration and visual data processing, including advanced topics such as feature extraction, object localization, simultaneous localization and mapping (SLAM) and semantic scene interpretation.

Workload

90h

T 11.360 Course: Safety Engineering [T-MACH-105171]

Responsible: Hans-Peter Kany
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102629 - Major Field: Logistics and Material Flow Theory
M-MACH-102636 - Major Field: Thermal Turbomachines
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2117061	Safety Engineering	2 SWS	Lecture (V)	Kany
Exams					
SS 2019	7600017	Safety Engineering		Prüfung (PR)	Kany

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Safety Engineering
2117061, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:
presentations

Notes

Media

Presentations

Learning content

The course provides basic knowledge of safety engineering. In particular the basics of health at the working place, job safety in Germany, national and European safety rules and the basics of safe machine design are covered. The implementation of these aspects will be illustrated by examples of material handling and storage technology. This course focuses on: basics of safety at work, safety regulations, basic safety principles of machine design, protection devices, system security with risk analysis, electronics in safety engineering, safety engineering for storage and material handling technique, electrical dangers and ergonomics. So, mainly, the technical measures of risk reduction in specific technical circumstances are covered.

Learning goals

The students are able to:

- Name and describe relevant safety concepts of safety engineering,
- Discuss basics of health at work and labour protection in Germany,
- Evaluate the basics for the safe methods of design of machinery with the national and European safety regulations and
- Realize these objectives by using examples in the field of storage and material handling systems.

Recommendations

None

Workload

Regular attendance: 21 hours
Self-study: 99 hours

Note

Dates: See IFL-Homepage

Learning Content

The course provides basic knowledge of safety engineering. In particular the basics of health at the working place, job safety in Germany, national and European safety rules and the basics of safe machine design are covered. The implementation of these aspects will be illustrated by examples of material handling and storage technology. This course focuses on: basics of safety at work, safety regulations, basic safety principles of machine design, protection devices, system security with risk analysis, electronics in safety engineering, safety engineering for storage and material handling technique, electrical dangers and ergonomics. So, mainly, the technical measures of risk reduction in specific technical circumstances are covered.

Annotation

none

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Defren/Wickert: Sicherheit für den Maschinen- und Anlagenbau, Druckerei und
Verlag: H. von Ameln, Ratingen, ISBN: 3-926069-06-6

T 11.361 Course: Scaling in Fluid Dynamics [T-MACH-105400]

Responsible: Prof. Dr. Leo Bühler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102634 - Major Field: Fluid Mechanic

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2154044	Scaling in fluid dynamics	2 SWS	Lecture (V)	Bühler
Exams					
SS 2019	76-T-MACH-105400	Scaling in Fluid Dynamics		Prüfung (PR)	Bühler

Competence Certificate
Oral exam

Duration: 20-30 minutes

No auxiliary means

Prerequisites
none

Recommendation
Fluid Mechanics (T-MACH-105207)

Below you will find excerpts from events related to this course:

V Scaling in fluid dynamics
2154044, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

- Introduction
- Similarity rules (examples)
- Dimensional analysis (Pi-theorem)
- Scaling in differential equations
- Scaling in boundary layers
- Self-similar solutions
- Scaling in turbulent shear layers
- Rotating flows
- Magnetohydrodynamic flows

Educational objective: The student can extract non-dimensional number from the characteristic properties of flows. From the insights on scaling laws, the students are qualified to identify the influencing quantities from generic experiments and transfer these to real applications. The students can simplify the governing equations of fluid mechanic appropriately and can interpret the achieved results as a basis for efficient solution strategies.

Learning Content

- Introduction
- Similarity rules (examples)
- Dimensional analysis (Pi-theorem)
- Scaling in differential equations
- Scaling in boundary layers
- Self-similar solutions
- Scaling in turbulent shear layers
- Rotating flows
- Magnetohydrodynamic flows

Annotation
Recommendation: Fluid Mechanics

Workload
Regular attendance: 32 hours

self-study: 88 hours

Literature
G. I. Barenblatt, 1979, Similarity, Self-Similarity, and Intermediate Asymptotics, Plenum Publishing Corporation (Consultants Bureau)

J. Zierep, 1982, Ähnlichkeitsgesetze und Modellregeln der Strömungsmechanik, Braun

J. H. Spurk, 1992, Dimensionsanalyse in der Strömungslehre, Springer

T 11.362 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-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Written examination	5	Each winter term	2

Events					
WS 19/20	2181738	Scientific computing for Engineers	2 SWS	Lecture (V)	Weygand, Gumbsch
WS 19/20	2181739	Exercises for Scientific Computing for Engineers	2 SWS	Practice (Ü)	Weygand
Exams					
SS 2019	76-T-MACH-100532	Scientific Computing for Engineers		Prüfung (PR)	Weygand, Gumbsch

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).

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105390 - Application of Advanced Programming Languages in Mechanical Engineering must not have been started.

Below you will find excerpts from events related to this course:

V Scientific computing for Engineers

Lecture (V)

2181738, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
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

Learning 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.

Annotation
The lecture can not be combined with the lecture "Application of advanced programming languages in mechanical engineering" (2182735).

Workload
regular attendance: 22,5 hours
Lab: 22,5 hours (optional)
self-study: 75 hours

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)**
2181739, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Exercises for the different topics of the lecture "Scientific computing for Engineers" (2181738)

Learning Content
Exercises for the different topics of the lecture "Scientific computing for Engineers" (2181738)

Workload
regular attendance: 22,5 hours

Literature
lecture notes "Scientific computing for Engineers" (2181738)

T 11.363 Course: Selected Applications of Technical Logistics [T-MACH-102160]

Responsible: Viktor Milushev
Dr.-Ing. Martin Mittwollen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2118087	Selected Applications of Technical Logistics	3 SWS	Lecture (V)	Mittwollen, Milushev
Exams					
SS 2019	76-T-MACH-102160	Selected Applications of Technical Logistics		Prüfung (PR)	Mittwollen

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

Recommendation
Knowledge out of Basics of Technical Logistics (T-MACH-102163) / Elements and Systems of Technical Logistics (T-MACH-102159) preconditioned

Below you will find excerpts from events related to this course:

V Selected Applications of Technical Logistics

2118087, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:
supplementary sheets,projector, blackboard

Notes
Details according schedule will be published

Learning Content

- design and dimension of machines from intralogistics
- static and dynamic behaviour
- operation properties and specifics
- Inside practical lectures: sample applications and calculations in addition to the lectures

Annotation
Knowledge out of **Basics of Technical Logistics** preconditioned

Workload
presence: 36h

rework: 84h

Literature
Recommendations during lessons

T 11.364 Course: Selected Applications of Technical Logistics - Project [T-MACH-108945]

Responsible: Viktor Milushev
Dr.-Ing. Martin Mittwollen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Examination of another type	2	Each summer term	1

Exams				
SS 2019	76-T-MACH-108945	Selected Applications of Technical Logistics - Project	Prüfung (PR)	Mittwollen

Competence Certificate
presentation of performed project and defense (30min) according to $4 (2), No. 3 of the examination regulation

Prerequisites
T-MACH-102160 (selected applications of technical logistics) must have been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102160 - Selected Applications of Technical Logistics must have been started.

Recommendation
Knowledge out of Basics of Technical Logistics (T-MACH-102163) / Elements and Systems of Technical Logistics (T-MACH-102159) preconditioned

T 11.365 Course: Selected Chapters of the Combustion Fundamentals [T-MACH-105428]

Responsible: Prof. Dr. Ulrich Maas
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102635 - Major Field: Engineering Thermodynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2167541	Selected chapters of the combustion fundamentals	2 SWS	Lecture (V)	Maas
WS 19/20	2167541	Selected chapters of the combustion fundamentals	2 SWS	Lecture (V)	Maas

Competence Certificate
Oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Selected chapters of the combustion fundamentals
2167541, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Blackboard and Powerpoint presentation

Learning Content
Depending on the lecture: Fundamentals of chemical kinetics, of statistical modeling of turbulent flames or of droplet and spray combustion.

Workload
Regular attendance: 21,5 hours
Self-study: 98,5 hours

Literature
Lecture notes

Combustion - Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, authors: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

V Selected chapters of the combustion fundamentals
2167541, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Blackboard and Powerpoint presentation

Learning Content
Depending on the lecture: Fundamentals of chemical kinetics, of statistical modeling of turbulent flames or of droplet and spray combustion.

Workload
Regular attendance: 22.5 h
Self-study: 97.5 h

Literature
Lecture notes

Combustion - Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, authors: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

T 11.366 Course: Selected Problems of Applied Reactor Physics and Exercises [T-MACH-105462]

Responsible: Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190411	Selected Problems of Applied Reactor Physics and Exercises	2 SWS	Lecture (V)	Dagan
Exams					
SS 2019	76-T-MACH-105462	Selected Problems of Applied Reactor Physics and Exercises		Prüfung (PR)	Dagan, Stieglitz
WS 19/20	76-T-MACH-105462	Selected Problems of Applied Reactor Physics and Exercises		Prüfung (PR)	Dagan, Stieglitz

Competence Certificate
oral exam, 1/2 hour

Prerequisites
none

Below you will find excerpts from events related to this course:

V Selected Problems of Applied Reactor Physics and Exercises
2190411, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

- Nuclear energy and forces
- Radioactive decay
- Nuclear processes
- Fission and the importance of delayed neutrons
- Basics of nuclear cross sections
- Principles of chain reaction
- Static theory of mono energetic reactors
- Introduction to reactor kinetic
- student laboratory

The students

- have solid understanding of the basic reactor physics
- are able to estimate processes of growth and decay of radionuclides; out of it, they can perform dose calculation and introduce their biological hazards
- can calculate the relationship of basic parameters which are needed for a stable reactor operation
- understand important dynamical processes of nuclear reactors.

Regular attendance: 26 h

self study 94 h

oral exam about 30 min.

Learning Content

- Nuclear energy and forces
- Radioactive decay
- Nuclear processes
- Fission and the importance of delayed neutrons
- Basics of nuclear cross sections
- Principles of chain reaction
- Static theory of mono energetic reactors
- Introduction to reactor kinetic
- student laboratory

Workload
Regular attendance: 26 h

self study 94 h

Literature
K. Wirtz Basics of Reactor technic Par I, II, Technic School Karlsruhe 1966 (in German)

D. Emendorfer. K.H. Höcker Theory of nuclear reactions, BI- Hochschultaschenbücher 1969 (in German)

J. Duderstadt and L. Hamilton, Nuclear reactor Analysis, J. Wiley $ Sons, Inc. 1975.

T 11.367 Course: Seminar Data-Mining in Production [T-MACH-108737]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Examination of another type	3	Each term	1

Events					
SS 2019	2151643	Seminar Data Mining in Production	2 SWS	Seminar (S)	Lanza
WS 19/20	2151643	Seminar Data Mining in Production	2 SWS	Seminar (S)	Lanza
Exams					
SS 2019	76-T-MACH-108737	Seminar Data-Mining in Production		Prüfung (PR)	Lanza

Competence Certificate
alternative test achievement (graded):

- written elaboration (workload of at least 80 h)
- oral presentation (approx. 30 min)

Prerequisites
none

Annotation
The number of students is limited to twelve. Dates and deadlines for the seminar will be announced at https://www.wbk.kit.edu/studium-und-lehre.php.

Below you will find excerpts from events related to this course:

V Seminar Data Mining in Production
2151643, SS 2019, 2 SWS, Language: German, Open in study portal

Seminar (S)

Description
Media:

KNIME Analytics Platform

Notes
In the age of Industry 4.0, large amounts of production data are generated by the global production networks and value chains. Their analysis enables valuable conclusions about production and lead to an increasing process efficiency. The aim of the seminar is to get to know production data analysis as an important component of future industrial projects. The students get to know the data mining tool KNIME and use it for analyses. A specific industrial use case with real production data enables practical work and offers direct references to industrial applications. The participants learn selected methods of data mining and apply them to the production data. The work within the seminar takes place in small groups on the computer. Subsequently, presentations on specific data mining methods have to be prepared.

Learning Outcomes:

The students ...

- can name, describe and distinguish between different methods, procedures and techniques of production data analysis.
- can perform basic data analyses with the data mining tool KNIME.
- can analyze and evaluate the results of data analyses in the production environment.
- are able to derive suitable recommendations for action.
- are able to explain and apply the CRISP-DM model.

Workload:

regular attendance: 10 hours
self-study: 80 hours

Learning Content
In the age of Industry 4.0, large amounts of production data are generated by the global production networks and value chains. Their analysis enables valuable conclusions about production and lead to an increasing process efficiency. The aim of the seminar is to get to know production data analysis as an important component of future industrial projects. The students get to know the data mining tool KNIME and use it for analyses. A specific industrial use case with real production data enables practical work and offers direct references to industrial applications. The participants learn selected methods of data mining and apply them to the production data. The work within the seminar takes place in small groups on the computer. Subsequently, presentations on specific data mining methods have to be prepared.

Annotation
The number of students is limited to twelve. Dates and deadlines for the seminar will be announced at https://www.wbk.kit.edu/studium-und-lehre.php.

Workload
regular attendance: 10 hours
self-study: 80 hours

V **Seminar Data Mining in Production** **Seminar (S)**
2151643, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

KNIME Analytics Platform

Notes

In the age of Industry 4.0, large amounts of production data are generated by the global production networks and value chains. Their analysis enables valuable conclusions about production and lead to an increasing process efficiency. The aim of the seminar is to get to know production data analysis as an important component of future industrial projects. The students get to know the data mining tool KNIME and use it for analyses. A specific industrial use case with real production data enables practical work and offers direct references to industrial applications. The participants learn selected methods of data mining and apply them to the production data. The work within the seminar takes place in small groups on the computer. Subsequently, presentations on specific data mining methods have to be prepared.

Learning Outcomes:

The students ...

- can name, describe and distinguish between different methods, procedures and techniques of production data analysis.
- can perform basic data analyses with the data mining tool KNIME.
- can analyze and evaluate the results of data analyses in the production environment.
- are able to derive suitable recommendations for action.
- are able to explain and apply the CRISP-DM model.

Workload:

regular attendance: 10 hours
self-study: 80 hours

Learning Content

In the age of Industry 4.0, large amounts of production data are generated by the global production networks and value chains. Their analysis enables valuable conclusions about production and lead to an increasing process efficiency. The aim of the seminar is to get to know production data analysis as an important component of future industrial projects. The students get to know the data mining tool KNIME and use it for analyses. A specific industrial use case with real production data enables practical work and offers direct references to industrial applications. The participants learn selected methods of data mining and apply them to the production data. The work within the seminar takes place in small groups on the computer. Subsequently, presentations on specific data mining methods have to be prepared.

Annotation

The number of students is limited to twelve. Dates and deadlines for the seminar will be announced at https://www.wbk.kit.edu/studium-und-lehre.php.

Workload

regular attendance: 10 hours
self-study: 80 hours

T 11.368 Course: Seminar for Rail System Technology [T-MACH-108692]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102641 - Major Field: Rail System Technology

Type	Credits	Recurrence	Version
Examination of another type	3	Each term	2

Events					
SS 2019	2115009	Seminar for Rail System Technology	1 SWS	Seminar (S)	Gratzfeld
WS 19/20	2115009	Seminar for Rail System Technology	1 SWS	Seminar (S)	Gratzfeld
Exams					
SS 2019	76-T-MACH-00002	Seminar for Rail System Technology		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-00002	Seminar for Rail System Technology		Prüfung (PR)	Gratzfeld

Competence Certificate
Examination: Writing a Seminararbeit, final presentation

Prerequisites
none

Below you will find excerpts from events related to this course:

V Seminar for Rail System Technology

2115009, SS 2019, 1 SWS, Language: German, Open in study portal

Seminar (S)

Notes

- Railway system: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact, history, challenges and future developments in the context of mega trends
- Operation: Transportation, public/regional/long-distance transport, freight service, scheduling
- System structure of railway vehicles: Tasks and classification, main systems
- Project management: definitions, project management, main and side processes, transfer to practice
- Scientific working: structuring and writing of scientific papers, literature research, scheduling (mile stones), self-management, presentation skills, using the software Citavi for literature and knowledge management, working with templates in Word, giving and taking feedback
- The learnt knowledge regarding scientific writing is used to elaborate a Seminararbeit. To this the students create a presentation, train and reflect it and finally present it to an auditorium.

Learning Content

- Railway system: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact, history, challenges and future developments in the context of mega trends
- Operation: Transportation, public/regional/long-distance transport, freight service, scheduling
- System structure of railway vehicles: Tasks and classification, main systems
- Project management: definitions, project management, main and side processes, transfer to practice
- Scientific working: structuring and writing of scientific papers, literature research, scheduling (mile stones), self-management, presentation skills, using the software Citavi for literature and knowledge management, working with templates in Word, giving and taking feedback
- The learnt knowledge regarding scientific writing is used to elaborate a Seminararbeit. To this the students create a presentation, train and reflect it and finally present it to an auditorium.

Workload
Regular attendance: 21 hours

Self-study (writing Seminararbeit): 65 hours

Final presentation (including preparation): 4 hours

Literature
A bibliography is available for download (Ilias-platform).

V **Seminar for Rail System Technology** **Seminar (S)**
2115009, WS 19/20, 1 SWS, Language: German, Open in study portal

Notes

- Railway system: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact, history, challenges and future developments in the context of mega trends
- Operation: Transportation, public/regional/long-distance transport, freight service, scheduling
- System structure of railway vehicles: Tasks and classification, main systems
- Project management: definitions, project management, main and side processes, transfer to practice
- Scientific working: structuring and writing of scientific papers, literature research, scheduling (mile stones), self-management, presentation skills, using the software Citavi for literature and knowledge management, working with templates in Word, giving and taking feedback
- The learnt knowledge regarding scientific writing is used to elaborate a Seminararbeit. To this the students create a presentation, train and reflect it and finally present it to an auditorium.

Learning Content

- Railway system: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact, history, challenges and future developments in the context of mega trends
- Operation: Transportation, public/regional/long-distance transport, freight service, scheduling
- System structure of railway vehicles: Tasks and classification, main systems
- Project management: definitions, project management, main and side processes, transfer to practice
- Scientific working: structuring and writing of scientific papers, literature research, scheduling (mile stones), self-management, presentation skills, using the software Citavi for literature and knowledge management, working with templates in Word, giving and taking feedback
- The learnt knowledge regarding scientific writing is used to elaborate a Seminararbeit. To this the students create a presentation, train and reflect it and finally present it to an auditorium.

Workload
Regular attendance: 21 hours

Self-study (writing Seminararbeit): 65 hours

Final presentation (including preparation): 4 hours

Literature
A bibliography is available for download (Ilias-platform).

11.369 Course: Signals and Systems [T-ETIT-109313]

Responsible: Prof. Dr.-Ing. Fernando Puente León
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics

Type	Credits	Recurrence	Expansion	Version
Written examination	6	Each winter term	1 terms	1

Events					
WS 19/20	2302109	Signals and Systems	2 SWS	Lecture (V)	Puente León

Prerequisites
none

T 11.370 Course: Simulation of Coupled Systems [T-MACH-105172]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Yusheng Xiang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102630 - Major Field: Mobile Machines
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2114095	Simulation of Coupled Systems	2 SWS	Lecture (V)	Geimer, Xiang
Exams					
SS 2019	76T-MACH-102172	Simulation of Coupled Systems		Prüfung (PR)	Geimer
SS 2019	76T-MACH-105172	Simulation of Coupled Systems		Prüfung (PR)	Geimer
WS 19/20	76T-MACH-105172	Simulation of Coupled Systems		Prüfung (PR)	Geimer

Competence Certificate
The assessment consists of an oral exam (20 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at very ordinary examination date.

A registration in mandatory, the details will be announced on the webpages of the *Institute of Vehicle System Technology / Institute of Mobile Machines*. In case of too many applications, attendance will be granted based on pre-qualification.

Prerequisites
Required for the participation in the examination is the preparation of a report during the semester. The partial service with the code T-MACH-108888 must have been passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108888 - Simulation of Coupled Systems - Advance must have been passed.

Recommendation

- Knowledge of ProE (ideally in actual version)
- Basic kniwledge of Matlab/Simulink
- Basic knowledge of dynamics of machnies
- Basic knowledge of hydraulics

Annotation
After completion of course, students are able to:

- build a coupled simulation
- parametrize models
- perform simulations
- conduct troubleshooting
- check results for plausibility

The number of participants is limited.

Content:

- Basics of multi-body and hydralics simulation programs
- Possibilities of coupled simulations
- Modelling and Simulation of Mobile Machines using a wheel loader
- Documentation of the result in a short report

Literature:

Software guide books (PDFs)

Information about wheel-type loader specifications

Below you will find excerpts from events related to this course:

V **Simulation of Coupled Systems** **Lecture (V)**
2114095, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content

- Knowledge of the basics of multi-body and hydraulic simulation programs
- Possibilities of coupled simulations
- Development of a simulation model by using the example of a wheel loader
- Documentation of the result in a short report

Workload

- regular attendance: 21 hours
- total self-study: 92 hours

Literature
Elective literature:

- miscellaneous guides according the software-tools pdf-shaped
- information to the wheel-type loader

T 11.371 Course: Simulation of Coupled Systems - Advance [T-MACH-108888]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Yusheng Xiang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102630 - Major Field: Mobile Machines
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics

Type	Credits	Recurrence	Version
Completed coursework	0	Each summer term	1

Exams				
SS 2019	76-T-MACH-108888	Simulation of Coupled Systems - Advance	Prüfung (PR)	Geimer
WS 19/20	76-T-MACH-108888	Simulation of Coupled Systems - Advance	Prüfung (PR)	Geimer

Competence Certificate
Preparation of semester report

Prerequisites
none

T 11.372 Course: Simulation of Optical Systems [T-MACH-105990]

Responsible: PD Dr.-Ing. Ingo Sieber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102601 - Major Field: Automation Technology
M-MACH-102615 - Major Field: Medical Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2105018	Simulation of Optical Systems	2 SWS	Lecture (V)	Sieber
Exams					
SS 2019	76-T-MACH-105990	Simulation of Optical Systems		Prüfung (PR)	Sieber

Competence Certificate
oral exam (Duration: 20min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Simulation of Optical Systems
2105018, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

This lecture gives an introduction into optical system's design. The focus is on the system concept: design for manufacture, reliability in operation, as well as interactions between optical and non-optical system components are considered. Practical aspects of optical systems design like e.g. the consideration of design rules to ensure
manufacturability, tolerancing of the optical system to ensure a reliable operation, and the coupling of optical and mechanical simulation tools will also be presented. Application of the acquired techniques will be deepened with the help of three case studies.

Content:

- Introduction
- Modeling, simulation, and systems design
- Basics of optics
- Properties of optical materials
- Optical imaging
- Ray tracing
- The optical design process
- Basics of the Finite-Element Method (FEM)
- The FEM design process
- Coupling of simulation tools
- Microoptical sub-systems

Learning objectives:

The students...

- know the basics of optical modeling and simulation.
- know the basics of modeling and simulation by means of the Finite-Element Method.
- know the basics of the optical and mechanical design process.
- are able to understand the specifications of optical systems and can use them in optical modeling.
- are able to use design rules.
- are able to conduct basic tolerance analysis.
- are able to assess the need of an inter-domain simulation.

Learning Content

- Introduction
- Modeling, simulation, and systems design
- Basics of optics
- Properties of optical materials
- Optical imaging
- Ray tracing
- The optical design process
- Basics of the Finite-Element Method (FEM)
- The FEM design process
- Coupling of simulation tools
- Microoptical sub-systems

Workload

regular attendance: 21 hours
self-study: 99 hours

T 11.373 Course: Simulation of the process chain of continuously fiber reinforced composite structure [T-MACH-105971]

Responsible: Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102632 - Major Field: Polymer Engineering
M-MACH-102646 - Major Field: Applied Mechanics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114107	Simulation der Prozesskette kontinuierlich verstärkter Faserverbundbauteile	2 SWS	Lecture (V)	Kärger

Competence Certificate
oral exam, 20 minutes

Prerequisites
none

T 11.374 Course: Simulator Exercises Combined Cycle Power Plants [T-MACH-105445]

Responsible: Prof. Dr.-Ing. Thomas Schulenberg
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	2	Each summer term	1

Events					
SS 2019	2170491	Simulator Exercises Combined Cycle Power Plants	2 SWS	Practical course (P)	Schulenberg
Exams					
SS 2019	76-T-MACH-105445	Simulator Exercises Combined Cycle Power Plants		Prüfung (PR)	Schulenberg

Competence Certificate
oral exam (ca. 15 min)

Prerequisites
none

Recommendation
Participation at LV-No. 2170490 "Combined Cycle Power Plants" (T-MACH-105444) is recommended.

Below you will find excerpts from events related to this course:

V Simulator Exercises Combined Cycle Power Plants
2170491, SS 2019, 2 SWS, Language: English, Open in study portal

Practical course (P)

Description
Media:

The power plant simulator is based on the control system of a real SIEMENS power plant. The English user surface is based on US standard.

Notes
The training objective of the course is the qualification for a research-related professional activity in power plant engineering. On the basis of the learned fundamentals in thermodynamics, in instrumentation and control engineering, as well as on the basis of the acquired knowledge of design of combined cycle plants, the participants can operate a real combined cycle power plant. This application creates a deeper understanding of the dynamic processes of the power plant, the specific importance of the plant components and the limits of the load capacity of the components. Participants can optimize normal operation and analyze incidents. They can work self-organized and reflexive. They have communicative and organizational skills in teamwork, even under major technical challenges.

Start-up of the power plant from scratch; load changes and shut down; dynamic response of the power plant in case of malfuctions and of sudden load changes; manual operation of selected components.

Learning Content
Start-up of the power plant from scratch; load changes and shut down; dynamic response of the power plant in case of malfuctions and of sudden load changes; manual operation of selected components.

Annotation
Recommendation: Participation at the lecture Combined Cycle Power Plants (2170490) is recommended.

Workload
Regular attendance: 20 hours

Self study: 40 hours

Literature
Slides and other documents of the lecture Combined Cycle Power Plants.

T 11.375 Course: Solar Thermal Energy Systems [T-MACH-106493]

Responsible: Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102623 - Major Field: Fundamentals of Energy Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2189400	Solar Thermal Energy Systems	2 SWS	Lecture (V)	Dagan
Exams					
SS 2019	76-T-MACH-106493	Solar Thermal Energy Systems		Prüfung (PR)	Dagan, Stieglitz
WS 19/20	76-T-MACH-106493	Solar Thermal Energy Systems		Prüfung (PR)	Dagan, Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Recommendation
Literature

1. "Solar Engineering of Thermal Processes", 4th Edition, J. Duffie &W. Beckman. Published by Wiley & Sons
2. “Heat Transfer”, 10th Edition, J. P. Holman Mc. Graw Hill publisher
3. “Fundamentals of classical Thermodynamics”, G. Van Wylen & R. E. Sonntag. Published by Wiley &Sons

Below you will find excerpts from events related to this course:

V Solar Thermal Energy Systems **Lecture (V)**
2189400, WS 19/20, 2 SWS, Language: English, Open in study portal

Notes

The course deals with fundamental aspects of solar energy

1. Introduction to solar energy – global energy panorama

2. Solar energy resource-

Structure of the sun, Black body radiation, solar constant, solar spectral distribution

Sun-Earth geometrical relationship

3. Passive and active solar thermal applications.

4. Solar thermal systems- solar collector-types, concentrating collectors, solar towers,

Heat losses, efficiency

5. Selected topics on thermodynamics and heat transfer which are relevant for solar systems.

6. Introduction to Solar induced systems: Wind , Heat pumps, Biomass , Photovoltaic

7. Energy storage

The course deals with fundamental aspects of solar energy. Starting from a global energy panorama the course deals with the sun as a thermal energy source. In this context, basic issues such as the sun’s structure, blackbody radiation and solar–earth geometrical relationship are discussed. In the next part, the lectures cover passive and active thermal applications and review various solar collector types including concentrating collectors and solar towers and the concept of solar tracking. Further, the collector design parameters determination is elaborated, leading to improved efficiency. This topic is augmented by a review of the main laws of thermodynamics and relevant heat transfer mechanisms.

The course ends with an overview on energy storage concepts which enhance practically the benefits of solar thermal energy systems.

The students get familiar with the global energy demand and the role of renewable energies learn about improved designs for using efficiently the potential of solar energy gain basic understanding of the main thermal hydraulic phenomena which support the work on future innovative applications will be able to evaluate quantitatively various aspects of the thermal solar systems.

Total 120 h, hereof 30 h contact hours and 90 h homework and self-studies

oral exam about 30 min.

Learning Content

The course deals with fundamental aspects of solar energy

1. Introduction to solar energy – global energy panorama

2. Solar energy resource-

Structure of the sun, Black body radiation, solar constant, solar spectral distribution

Sun-Earth geometrical relationship

3. Passive and active solar thermal applications.

4. Solar thermal systems- solar collector-types, concentrating collectors, solar towers,

Heat losses, efficiency

5. Selected topics on thermodynamics and heat transfer which are relevant for solar systems.

6. Introduction to Solar induced systems: Wind , Heat pumps, Biomass , Photovoltaic

7. Energy storage

The course deals with fundamental aspects of solar energy. Starting from a global energy panorama the course deals with the sun as a thermal energy source. In this context, basic issues such as the sun’s structure, blackbody radiation and solar–earth geometrical relationship are discussed. In the next part, the lectures cover passive and active thermal applications and review various solar collector types including concentrating collectors and solar towers and the concept of solar tracking. Further, the collector design parameters determination is elaborated, leading to improved efficiency. This topic is augmented by a review of the main laws of thermodynamics and relevant heat transfer mechanisms.

The course ends with an overview on energy storage concepts which enhance practically the benefits of solar thermal energy systems.

Workload

Total 120 h, hereof 30 h contact hours and 90 h homework and self-studies

T 11.376 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-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	3

Events					
WS 19/20	2193003	Solid State Reactions and Kinetics of Phase Transformations (with exercises)	2 SWS	Lecture (V)	Franke
Exams					
SS 2019	76-T-MACH-107667	Solid State Reactions and Kinetics of Phase		Prüfung (PR)	Seifert, Franke

Competence Certificate
oral examination (about 30 min)

Prerequisites
The successful participation in Exercises for Solid State Reactions and Kinetics of Phase Transformations is the condition for the admittance to the oral exam in Solid State Reactions and Kinetics of Phase.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107632 - Exercises for Solid State Reactions and Kinetics of Phase Transformations must have been passed.

Recommendation
Bacic course in materials science and engineering

Basic course in mathematics

physical chemistry

Below you will find excerpts from events related to this course:

V Solid State Reactions and Kinetics of Phase Transformations (with exercises) **Lecture (V)**
2193003, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Oral examination (about 30 min)

Teaching Content:

1. Crystal Defects and Mechanisms of Diffusion
2. Microscopic Description of Diffusion
3. Phenomenological Treatment
4. Diffusion Coefficients
5. Diffusion Problems; Analytical Solutions
6. Diffusion with Phase Transformation
7. Kinetics of Microstructural Transformations
8. Diffusion at Surfaces, Grain Boundaries and Dislocations
9. Numerical treatment of diffusion controlled phase transformations

Recommendations:

knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (Seifert); Bacic course in materials science and Engineering; Basic course in mathematics; physical chemistry

regular attendance: 22 hours

self-study: 98 hours

The students acquire knowledge about:

- diffusion mechanisms
- Fick's laws
- basic solutions of the diffusion equation
- evaluation of diffusion experiments
- interdiffusion processes
- the thermodynamic factor
- parabolic growth of layers
- formation of pearlite
- microstructural transformations according to the models of Avrami and Johnson-Mehl
- TTT diagrams

Learning Content
1. Crystal Defects and Mechanisms of Diffusion
2. Microscopic Description of Diffusion
3. Phenomenological Treatment
4. Diffusion Coefficients
5. Diffusion Problems; Analytical Solutions
6. Diffusion with Phase Transformation
7. Kinetics of Microstructural Transformations
8. Diffusion at Surfaces, Grain Boundaries and Dislocations
9. Numerical treatment of diffusion controlled phase transformations

Workload
regular attendance: 22 hours

self-study: 98 hours

Literature
1. J. Crank, "The Mathematics of Diffusion", 2nd Ed., Clarendon Press, Oxford, 1975.
2. J. Philibert, "Atom Movements", Les Éditions de Physique, Les Ulis, 1991.
3. D.A. Porter, K.E. Easterling, M.Y. Sherif, "Phase Transformations in Metals and Alloys", 3rd edition, CRS Press, 2009.
4. H. Mehrer, "Diffusion in Solids", Springer, Berlin, 2007.

T 11.377 Course: Stability: from order to chaos [T-MACH-108846]

Responsible: Prof. Dr. Andreas Class
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102595 - Compulsory Elective Module Natural Science/Computer Science/Electrical Engineering

Type	Credits	Recurrence	Version
Completed coursework (oral)	6	Each summer term	1

Events					
SS 2019	2154437	Hydrodynamic Stability: From Order to Chaos	2 SWS	Lecture (V)	Class
Exams					
SS 2019	76-T-MACH-108846	Stability: from order to chaos		Prüfung (PR)	Class

Competence Certificate
The study performance is considered to have been passed if all exercise assignments have been successfully processed and the final colloquium (30 minutes) has been successfully passed.

no auxiliary

Prerequisites
The partial performance number T-MACH-105425 "Hydrodynamic Stability: From Order to Chaos" must not be startet or completed. The partial services T-MACH-108846 "Stability: from order to chaos" (Nat/Inf/Etit) and T-MACH-105425 "Hydrodynamic Stability: From Order to Chaos" are mutually exclusive.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105425 - Hydrodynamic Stability: From Order to Chaos must not have been started.

Recommendation
Fluid Mechanics (T-MACH-105207)

Mathematical Methods in Fluid Mechanics (T-MACH-105295)

Below you will find excerpts from events related to this course:

V Hydrodynamic Stability: From Order to Chaos

2154437, SS 2019, 2 SWS, Language: German/English, Open in study portal

Lecture (V)

Description
Media:

Black board

Notes

The studends can apply the analytic and numerical methods for an evaluation of stability properties of hydrodynamic systems. The are qualified to discuss the characteristic influence of parameter changes (e.g. Renolds number) on the calculated results with respect to the flow character and properties (e.g. transition laminar/turbulent flow).

Increasing a control parameter of a thermohydraulic system, e.g. the Reynolds number, the initial flow pattern (e.g. stationary flow) can be replaced by a different pattern (e.g. turbulent flow).

Typical hydrodynamic instabilities are summarized in the lecture.
The systematic analysis of thermohydraulic stability problems is developed for the case of Rayleigh-Bernard convection (fluid layer heated from below) and selected examples from fluid dynamics.

Covered is:

- linear stability analysis: determine limiting control parameter value up to which the basic flow pattern is stable against small perturbations.
- nonlinear reduced order modeling, capable to characterize more complex flow patterns
- Lorenz system: a generic system exhibiting chaotic behavior

Learning Content

Increasing a control parameter of a thermohydraulic system, e.g. the Reynolds number, the initial flow pattern (e.g. stationary flow) can be replaced by a different pattern (e.g. turbulent flow).

Typical hydrodynamic instabilities are summarized in the lecture.
The systematic analysis of thermohydraulic stability problems is developed for the case of Rayleigh-Bernard convection (fluid layer heated from below) and selected examples from fluid dynamics.

Covered is:

- linear stability analysis: determine limiting control parameter value up to which the basic flow pattern is stable against small perturbations.
- nonlinear reduced order modeling, capable to characterize more complex flow patterns
- Lorenz system: a generic system exhibiting chaotic behavior

Annotation

Lecture also offered as a block-lecture within the AREVA Nuclear Professional School (www.anps.kit.edu)

Workload

regulare attendance: 21h

self-study: 99h

Literature

Script

T 11.378 Course: Strategic product development - identification of potentials of innovative products [T-MACH-105696]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr.-Ing. Andreas Siebe

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

Type	Credits	Recurrence	Version
Oral examination	3	Each summer term	2

Events					
SS 2019	2146198	Strategic product development - identification of potentials of innovative products	2 SWS	Lecture (V)	Siebe
Exams					
SS 2019	76-T-MACH-105696	Strategic product development - identification of potentials of innovative products		Prüfung (PR)	Siebe, Albers

Competence Certificate
Oral exam in small groups (30 minutes)

Prerequisites
The precondition of this partial work is the successful processing of a case study(T-MACH-110396): written elaboration & presentation of the results (15 minutes)

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110396 - Strategic product development - identification of potentials of innovative products - Case Study must have been passed.

Below you will find excerpts from events related to this course:

V Strategic product development - identification of potentials of innovative products

Lecture (V)

2146198, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Introduction into future management, Development of scenarios, scenariobased strategy development, trendmanagement, strategic early detection, innovation- and technologymanagement, scenarios in product development, from profiles of requirements to new products, examples out of industrial praxis.

Workload
regular attendance: 21 h

self-study: 99 h

T 11.379 Course: Strategic product development - identification of potentials of innovative products - Case Study [T-MACH-110396]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr.-Ing. Andreas Siebe

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102642 - Major Field: Development of Innovative Appliances and Power Tools

Type	Credits	Recurrence	Version
Completed coursework (practical)	1	Each summer term	1

Events					
SS 2019	2146198	Strategic product development - identification of potentials of innovative products	2 SWS	Lecture (V)	Siebe

Competence Certificate
Successful processing of a case study(T-MACH-110396): written elaboration & presentation of the results (15 minutes)

Below you will find excerpts from events related to this course:

V Strategic product development - identification of potentials of innovative products — Lecture (V)
2146198, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Introduction into future management, Development of scenarios, scenariobased strategy development, trendmanagement, strategic early detection, innovation- and technologymanagement, scenarios in product development, from profiles of requirements to new products, examples out of industrial praxis.

Workload
regular attendance: 21 h

self-study: 99 h

T 11.380 Course: Structural Analysis of Composite Laminates [T-MACH-105970]

Responsible: Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102632 - Major Field: Polymer Engineering
M-MACH-102646 - Major Field: Applied Mechanics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2113106	Structural Analysis of Composite Laminates	2 SWS	Lecture (V)	Kärger

Competence Certificate
oral exam, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Structural Analysis of Composite Laminates

Lecture (V)

2113106, WS 19/20, 2 SWS, Language: German, Open in study portal

Literature

H. Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.

E. J. Barbero: Finite Element Analysis of Composite Materials. ISBN: 1-4200-5433-3. CRC Press, Boca Raton, FL, 1. edition, 2008.

E. J. Barbero: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.

E. J. Barbero: Finite Element Analysis of Composite Materials Using Abaqus. ISBN: ISBN: 978-1-46-651661-8. CRC Press, Boca Raton, FL, 2013.

Isaac M. Daniel, Ori Ishai: Engineering Mechanics of Composite Materials. Oxford Univ Press; ISBN-13: 978-0195150971, 2. Edition, 2005.

Davila, C. G.; Camanho, P. P.; Rose, C. A.: Failure criteria for FRP laminates. Journal of Composite Materials 39: 323-345, 2005.

Hinton, M. J.; Kaddour, A. S.; Soden, P. D.: A comparison of the predictive capabilities of current failure theories for composite laminates, judged against experimental evidence. Composites Science and Technology 62: 1725-1797, 2002.

Puck, A.; Schürmann, H.: Failure analysis of FRP laminates by means of physically based phenomenological models. Composite Science and Technology 58: 1045-1067, 1998.

Reddy, J. N.: Mechanics of laminated composite plates and shells - Theory and Analysis. USA: CRC Press, Boca Raton, 2004.

Soden, P. D.; Kaddour, A. S.; Hinton, M. J.: Recommendations for designers and researchers resulting from the world-wide failure exercise. Composites Science and Technology 64: 589-604, 2004.

Stephen W. Tsai and J. Daniel D. Melo: Composite Materials Design and Testing. Composites Design Group, 978-0-9860845-1-5 Stanford University , 2015.

T 11.381 Course: Structural and Phase Analysis [T-MACH-102170]

Responsible: Dr.-Ing. Susanne Wagner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2125763	Structural and phase analysis	2 SWS	Lecture (V)	Wagner, Hinterstein
Exams					
SS 2019	76-T-MACH-102170	Structural and Phase Analysis		Prüfung (PR)	Wagner, Hinterstein
WS 19/20	76-T-MACH-102170	Structural and Phase Analysis		Prüfung (PR)	Wagner, Hinterstein

Competence Certificate
Oral examination

Prerequisites
none

Below you will find excerpts from events related to this course:

V Structural and phase analysis
2125763, WS 19/20, 2 SWS, Language: German, Open in study portal **Lecture (V)**

Learning Content
The course gives an overview to generation and detection of x-rays as well as their interaction with matter. It provides an introduction to crystallography and describes modern measurement and analysis methods of x-ray diffraction.

It is arranged in the following units:

- Generation and properties of X-Ray's
- Crystallography
- Fundamentals and application of different measuring methods
- Qualitative and quantitative phase analysis
- Texture analysis (pole figures)
- Residual stress measurements

Workload
regular attendance: 30 hours

self-study: 90 hours

Literature

1. Moderne Röntgenbeugung - Röntgendiffraktometrie für Materialwissenschaftler, Physiker und Chemiker, Spieß, Lothar / Schwarzer, Robert / Behnken, Herfried / Teichert, Gerd B.G. Teubner Verlag 2005
2. H. Krischner: Einführung in die Röntgenfeinstrukturanalyse. Vieweg 1990.
3. B.D. Cullity and S.R. Stock: Elements of X-ray diffraction. Prentice Hall New Jersey, 2001.

T 11.382 Course: Structural Ceramics [T-MACH-102179]

Responsible: Prof. Dr. Michael Hoffmann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102619 - Major Field: Technical Ceramics and Powder Materials

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2126775	Structural Ceramics	2 SWS	Lecture (V)	Hoffmann
Exams					
SS 2019	76-T-MACH-102179	Structural Ceramics		Prüfung (PR)	Hoffmann, Wagner, Schell
WS 19/20	76-T-MACH-102179	Structural Ceramics		Prüfung (PR)	Hoffmann, Wagner, Schell

Competence Certificate
Oral examination, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Structural Ceramics
2126775, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Slides for the lecture:

available under http://www.iam.kit.edu/km

Learning Content
The lecture gives an overview on structure and properties of the technical relevant structural ceramics silicon nitride, silicon carbide, alumina, zirconia, boron nitride and fibre-reinforced ceramics. All types of structural ceramics will be discussed in detail in terms of preparation methods of the raw materials, shaping techniques, densification, microstructural development, mechanical properties and application fields.

Annotation
The course will not take place every year.

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature
W.D. Kingery, H.K. Bowen, D.R. Uhlmann, "Introduction to Ceramics", John Wiley & Sons, New York, (1976)

E. Dörre, H. Hübner, "Aluminia", Springer Verlag Berlin, (1984)

M. Barsoum, "Fundamentals of Ceramics", McGraw-Hill Series in Material Science and Enginewering (2003)

T 11.383 Course: Structural Materials [T-MACH-100293]

Responsible: Dr.-Ing. Stefan Guth
Dr. Karl-Heinz Lang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	2

Events					
SS 2019	2174580	Structural Materials	4 SWS	Lecture / Practice (VÜ)	Lang
Exams					
SS 2019	76-T-MACH-100293	Structural Materials		Prüfung (PR)	Lang, Guth
WS 19/20	76-T-MACH-100293	Structural Materials		Prüfung (PR)	Lang, Guth

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Structural Materials
2174580, SS 2019, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes
Lectures and tutorialy on the topics:

- basic loading types and superimposed loadings
- high-temperature loading
- influence of notches
- uniaxial, multiaxial and superimposed cyclic loading
- notch fatigue
- structural durability
- impact of residual stresses
- basic principles of materials selection
- dimensioning of components

learning objectives:
The students are able to select materials for mechanical design and to dimension structural components according to the state of the art. They are familiar with the most important engineering materials. They can assess these materials on base of their characteristic properties and and they can match property profiles and requirement profiles. The dimensioning includes complex situations, such as multiaxial loading, notched components, static and dynamic loading, componetns with residual stresses and loading at high homologous temperatures.
requirements:
none
workload:

Precence: 42h

Self study: 138h

Learning Content

Lectures and tutorialy on the topics:

- basic loading types and superimposed loadings
- high-temperature loading
- influence of notches
- uniaxial, multiaxial and superimposed cyclic loading
- notch fatigue
- structural durability
- impact of residual stresses
- basic principles of materials selection
- dimensioning of components

Workload

Precence: 42h

Self study: 138h

T 11.384 Course: Superhard Thin Film Materials [T-MACH-102103]

Responsible: Prof. Dr. Sven Ulrich
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102637 - Major Field: Tribology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2177618	Superhard Thin Film Materials	2 SWS	Lecture (V)	Ulrich
Exams					
SS 2019	76-T-MACH-102103	Superhard Thin Film Materials		Prüfung (PR)	Ulrich

Competence Certificate
oral examination (ca. 30 Minuten)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Superhard Thin Film Materials

2177618, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
oral examination (about 30 min), no tools or reference materials

Teaching Content:

Introduction

Basics

Plasma diagnostics

Particle flux analysis

Sputtering and ion implantation

Computer simulations

Properties of materials, thin film deposition technology,
thin film analysis and modelling of superhard materials

Amorphous hydrogenated carbon

Diamond like carbon

Diamond

Cubic Boronnitride

Materials of the system metall-boron-carbon-nitrogen-silicon

regular attendance: 22 hours
self-study: 98 hours

Superhard materials are solids with a hardness higher than 4000 HV 0,05. The main topics of this lecture are modelling, deposition, characterization and application of superhard thin film materials.

Learning Content
Introduction

Basics

Plasma diagnostics

Particle flux analysis

Sputtering and ion implantation

Computer simulations

Properties of materials, thin film deposition technology,
thin film analysis and modelling of superhard materials

Amorphous hydrogenated carbon

Diamond like carbon

Diamond

Cubic Boronnitride

Materials of the system metall-boron-carbon-nitrogen-silicon

Workload
regular attendance: 22 hours
self-study: 98 hours

Literature
G. Kienel (Ed.): Vakuumbeschichtung 1 - 5, VDI Verlag, Düsseldorf, 1994

Copies with figures and tables will be distributed

T 11.385 Course: Supply Chain Management [T-MACH-105181]

Responsible: Dr.-Ing. Knut Alicke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102625 - Major Field: Information Technology of Logistic Systems

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

T 11.386 Course: Sustainable Product Engineering [T-MACH-105358]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr. Karl-Friedrich Ziegahn

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102599 - Major Field: Powertrain Systems
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102613 - Major Field: Lifecycle Engineering
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102633 - Major Field: Robotics
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2146192	Sustainable Product Engineering	2 SWS	Lecture (V)	Ziegahn

Competence Certificate
written exam (60 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Sustainable Product Engineering

2146192, SS 2019, 2 SWS, Open in study portal

Lecture (V)

Description
Media

- Beamer

Learning Content
understanding of sustainability objectives and their role in product development, the interaction between technical products and their environment, the holistic approach and the equality of economic, social and environmental aspects and environmental aspects

skills for life-cycle product design using the example of complex automotive components such as airbag systems and other current products

understanding of product environmental stresses with relevancy to praxis at the example of technology-intensive components, robustness and durability of products as the basis for a sustainable product development, development of skills for the application of environmental simulationduring the process of developement of technical products

delivery of key skills such as team skills / project / self / presentation based on realistic projects

Workload
regular attendance: 21 h

self-study: 99 h

T 11.387 Course: System Integration in Micro- and Nanotechnology [T-MACH-105555]

Responsible: Dr. Ulrich Gengenbach
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102615 - Major Field: Medical Technology
M-MACH-102633 - Major Field: Robotics
M-MACH-102647 - Major Field: Microactuators and Microsensors

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2106033	System Integration in Micro- and Nanotechnology	2 SWS	Lecture (V)	Gengenbach
Exams					
SS 2019	76-T-MACH-105555	System Integration in Micro- and Nanotechnology		Prüfung (PR)	Gengenbach

Competence Certificate
oral exam (Duration: 30 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V System Integration in Micro- and Nanotechnology

2106033, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

Content:

- Introduction
- Definition system integration
- Integration of mechanical functions (flexures)
- Plasma treatment of surfaces
- Adhesive bonding
    - Packaging
    - Low Temperature Cofired Ceramics (LTCC)
    - Assembly of hybrid systems

- Monolithic/hybrid system integration)
- Modular system integration

- Integration of electrical/electronic functions
- Mounting techniques
- molded Interconnect Devices (MID)
- Functional printing

- Coating
- Capping
- Housing

First steps towards system integration nanotechnology

Learning objectives:

Students acquire fundamental knowledge about challenges and system integration processes.

Learning Content

- Introduction
- Definition system integration
- Integration of mechanical functions (flexures)
- Plasma treatment of surfaces
- Adhesive bonding
    - Packaging
    - Low Temperature Cofired Ceramics (LTCC)
    - Assembly of hybrid systems

- Monolithic/hybrid system integration)
- Modular system integration

- Integration of electrical/electronic functions
- Mounting techniques
- molded Interconnect Devices (MID)
- Functional printing

- Coating
- Capping
- Housing

First steps towards system integration nanotechnology

Literature

- A. Risse, Fertigungsverfahren der Mechatronik, Feinwerk- und Präzisionsgerätetechnik, Vieweg+Teubner Verlag Wiesbaden, 2012
- M. Madou, Fundamentals of microfabrication and nanotechnology, CRC Press Boca raton, 2012
- G. Habenicht, Kleben Grundlagen, Technologien, Anwendungen, Springer-Verlag Berlin Heidelberg, 2009
- J. Franke, Räumliche elektronische Baugruppen (3D-MID), Carl Hanser-Verlag München, 2013

T 11.388 Course: Systematic Materials Selection [T-MACH-100531]

Responsible: Dr.-Ing. Stefan Dietrich
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	3

Events					
SS 2019	2174576	Systematic Materials Selection	3 SWS	Lecture (V)	Dietrich
SS 2019	2174577	Übungen zu 'Systematische Werkstoffauswahl'	1 SWS	Practice (Ü)	Dietrich, Mitarbeiter
Exams					
SS 2019	76-T-MACH-100531	Systematic Materials Selection		Prüfung (PR)	Dietrich
WS 19/20	76-T-MACH-100531	Systematic Materials Selection		Prüfung (PR)	Dietrich

Competence Certificate
The assessment is carried out as a written exam of 2 h.

Prerequisites
none

Recommendation
Basic knowledge in materials science, mechanics and mechanical design due to the lecture Materials Science I/II.

Below you will find excerpts from events related to this course:

V Systematic Materials Selection
Lecture (V)
2174576, SS 2019, 3 SWS, Language: German, Open in study portal

Notes
Important aspects and criteria of materials selection are examined and guidelines for a systematic approach to materials selection are deeloped. The following topics are covered:

- Information and introduction
- Necessary basics of materials
- Selected methods / approaches of the material selection
- Examples for material indices and materials property charts
- Trade-off and shape factors
- Sandwich materials and composite materials
- High temperature alloys
- Regard of process influences
- Material selection for production lines
- Incorrect material selection and the resulting consequences
- Abstract and possibility to ask questions

learning objectives:
The students are able to select the best material for a given application. They are proficient in selecting materials on base of performance indices and materials selection charts. They can identify conflicting objectives and find sound compromises. They are aware of the potential and the limits of hybrid material concepts (composites, bimaterials, foams) and can determine whether following such a concept yields a useful benefit.
requirements:

WiIng SPO 2007 (B.Sc.)

The course Material Science I [21760] has to be completed beforehand.

WiIng (M.Sc.)

The course Material Science I [21760] has to be completed beforehand.

workload:

The workload for the lecture is 120 h per semester and consists of the presence during the lecture (30 h) as well as preparation and rework time at home (30 h) and preparation time for the oral exam (60 h).

Learning Content
Important aspects and criteria of materials selection are examined and guidelines for a systematic approach to materials selection are deeloped. The following topics are covered:

- Information and introduction
- Necessary basics of materials
- Selected methods / approaches of the material selection
- Examples for material indices and materials property charts
- Trade-off and shape factors
- Sandwich materials and composite materials
- High temperature alloys
- Regard of process influences
- Material selection for production lines
- Incorrect material selection and the resulting consequences
- Abstract and possibility to ask questions

Workload
The workload for the lecture is 120 h per semester and consists of the presence during the lecture (30 h) as well as preparation and rework time at home (30 h) and preparation time for the oral exam (60 h).

Literature
Lecture notes; Problem sheets; Textbook: M.F. Ashby, A. Wanner (Hrsg.), C. Fleck (Hrsg.);
Materials Selection in Mechanical Design: Das Original mit Übersetzungshilfen
Easy-Reading-Ausgabe, 3. Aufl., Spektrum Akademischer Verlag, 2006
ISBN: 3-8274-1762-7

T 11.389 Course: Technical Design in Product Development [T-MACH-105361]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr.-Ing. Markus Schmid

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102605 - Major Field: Engineering Design

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2146179	Technical Design in Product Development	2 SWS	Lecture (V)	Schmid
Exams					
SS 2019	7600018	Technical Design in Product Development		Prüfung (PR)	Schmid
SS 2019	7600021	Technical Design in Product Development		Prüfung (PR)	Schmid

Competence Certificate
Written exam (20 min)

Only dictionary is allowed

Prerequisites
none

Below you will find excerpts from events related to this course:

V Technical Design in Product Development
2146179, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

- Beamer
- Models

Learning Content
Introduction
Relevant parameters on product value in Technical Design
Design in Methodical Development and Engineering and for a differentiated validation of products
Design in the concept stage of Product Development
Design in the draft and elaboration stage of Product Development

Workload
regular attendance: 21 h

self-study: 99 h

Literature
Hexact (R) Lehr- und Lernportal

11.390 Course: Technical Energy Systems for Buildings 1: Processes & Components [T-MACH-105559]

Responsible: Dr. Ferdinand Schmidt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102648 - Major Field: Energy Technology for Buildings

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2157200	Technical energy systems for buildings 1: Processes & components	2 SWS	Lecture (V)	Schmidt
Exams					
WS 19/20	76-T-MACH-105559	Technical Energy Systems for Buildings 1: Processes & Components		Prüfung (PR)	Schmidt

Competence Certificate
oral exam, 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

Technical energy systems for buildings 1: Processes & components

Lecture (V)

2157200, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Introduction to heating and cooling technologies for buildings, solar energy utilization in buildings (solar radiation, solar thermal energy, photovoltaics) and to energy storage in buildings (thermal and electric storage technologies). Topics covered:

- Burners, condensing and non-condensing boilers
- Cogeneration units for use in buildings
- Heat transformation: Fundamentals, vapor compression, absorption, adsorption
- Solar energy: Radiation, solar thermal collectors, photovoltaics
- energy storage in buildings: thermal and electric storage

Learning objectives:

Students know relevant technical components of energy supply systems in buildings (heating and cooling, dehumidification). They know the energy conversion processes associated with these components and can estimate their energy efficiencies as well as the most important factors influencing efficiency.

Students are familiar with the underlying physics (mostly thermodynamics) of the relevant processes. They can derive relevant figures of merit from these principles. They know the degree of technological development for the various processes and components and are aware of current research and development objectives in this field.

Oral exam: about 25 min.
No tools

T 11.391 Course: Technical Energy Systems for Buildings 2: System Concept [T-MACH-105560]

Responsible: Dr. Ferdinand Schmidt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102648 - Major Field: Energy Technology for Buildings

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2158201	Technical energy systems for buildings 2: System concepts	2 SWS	Lecture (V)	Schmidt
Exams					
WS 19/20	76-T-MACH-105560	Technical Energy Systems for Buildings 2: System Concept		Prüfung (PR)	Schmidt

Competence Certificate
oral exam, 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Technical energy systems for buildings 2: System concepts

Lecture (V)

2158201, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
Introduction of relevant figures of merit for technical energy systems in buildings. Description of different system concepts for energy supply of buildings (heating, cooling, dehumidification) and evaluation according to figures of merit. Systems covered include

- Heat pumps and heat pump systems including combination with solar thermal energy
- cogeneration and trigeneration system (heating, cooling, power)
- Solar thermal systems: Domestic hot water, heating support, cooling and dehumidification
- District heating systems including solar thermal heat
- Photovoltaics and heat pump systems including thermal and battery storage
- Grid-reactive building technology: Smart-Metering, Smart Home, Smart Grid

Learning outcomes:

Students are able to develop system concepts for technical energy systems in buildings and to rationally design such systems. They know the relevant figures of merit for an energy-related as well as an economical or combined evaluation of systems, and know how to employ these figures of merit in sizing systems and components. Students are able to employ plausibility checks and to give rough estimates on building energy concepts and they know which technologies can be combined for highly efficient system combinations.

Workload: 30 hours course attendance, 90 hours self-study

Oral exam appr. 25 minutes

T 11.392 Course: Technology of Steel Components [T-MACH-105362]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2174579	Technology of steel components	2 SWS	Lecture (V)	Schulze
Exams					
SS 2019	76-T-MACH-105362	Technology of Steel Components		Prüfung (PR)	Schulze

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Technology of steel components

2174579, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Meaning, Development and characterization of component states

Description of the influence of component state on mechanical properties

Stability of component states

Steel manufacturing

Component states due to forming

Component states due to heat treatments

Component states due to surface hardening

Component states due to machining

Component states due to mechanical surface treatments

Component states due to joining

Summarizing evaluation

learning objectives:
The students have the background to evaluate the influence of manufacture processes on the compound state of metallic compounds. The students can assess the influence and the stability of compound state under mechanical load. The students are capable to describe the individual aspects of interaction of the compound state of steel components due to forming, heat treatment, mechanical surface treatment and joining processes.
requirements:
Materials Science and Engineering I & II
workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content

Meaning, Development and characterization of component states

Description of the influence of component state on mechanical properties

Stability of component states

Steel manufacturing

Component states due to forming

Component states due to heat treatments

Component states due to surface hardening

Component states due to machining

Component states due to mechanical surface treatments

Component states due to joining

Summarizing evaluation

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Script will be distributed within the lecture

VDEh: Werkstoffkunde Stahl, Bd. 1: Grundlagen, Springer-Verlag, 1984

H.-J. Eckstein: Technologie der Wärmebehandlung von Stahl, Deutscher Verlag Grundstoffindustrie, 1977

H.K.D.H. Badeshia, R.W.K. Honeycombe, Steels - Microstructure and Properties, CIMA Publishing, 3. Auflage, 2006

V. Schulze: Modern Mechanical Surface Treatments, Wiley, Weinheim, 2005

T 11.393 Course: Ten Lectures on Turbulence [T-MACH-105456]

Responsible: Dr. Ivan Otic
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189904	Ten lectures on turbulence	2 SWS	Lecture (V)	Otic
Exams					
SS 2019	76-T-MACH-105456	Ten Lectures on Turbulence		Prüfung (PR)	Otic
WS 19/20	76-T-MACH-105456	Ten Lectures on Turbulence		Prüfung (PR)	Otic

Competence Certificate
oral exam, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Ten lectures on turbulence

2189904, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
1 Introduction
2 Turbulent transport of momentum and heat
3 Statistical description of turbulence
4 Scales of turbulent ows
5 Homogeneous turbulent shear ows
6 Free turbulent shear ows
7 Wall-Bounded turbulent ows
8 Turbulence Modelling
9 Reynolds Averaged Navier-Stokes (RANS) Simulation Approach
10 Large Eddy Simulation (LES) Approach

Workload
Time of attendence: 25 hours

Self-study: 100 hours

Literature
Reference texts:
- Lecture Notes
- Presentation slides

Recommended Books:
- Pope, S. B.: Turbulent Flows. Cambridge University Press , 2003.
- Hinze J. O.: Turbulence. McGraw-Hill, 1975.

T 11.394 Course: Theoretical Description of Mechatronic Systems [T-MACH-105521]

Responsible: Prof. Dr.-Ing. Wolfgang Seemann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102614 - Major Field: Mechatronics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2161117	Theoretical Description of Mechatronic Systems	2 SWS	Lecture (V)	Seemann

Competence Certificate
oral exam, approx. 30 min..

Prerequisites
none

T 11.395 Course: Theory of Stability [T-MACH-105372]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2019	2163113	Theory of Stability	2 SWS	Lecture (V)	Fidlin
SS 2019	2163114	Übungen zu Stabilitätstheorie	2 SWS	Practice (Ü)	Fidlin, Schröders
Exams					
SS 2019	76-T-MACH-105372	Theory of Stability		Prüfung (PR)	Fidlin

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Vibration theory, Mathematical Methods of Vibration Theory

Below you will find excerpts from events related to this course:

V Theory of Stability
2163113, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

- Basic concepts of stability
- Lyapunov's functions
- Direct lyapunov's methods
- Stability of equilibria positions
- Attraction area of a stable solution
- Stability according to the first order approximation
- Systems with parametric excitation
- Stability criteria in the control theory

Workload
time of attendance: 39 h
self-study: 201 h

Literature

- Pannovko Y.G., Gubanova I.I. Stability and Oscillations of Elastic Systems, Paradoxes, Fallacies and New Concepts. Consultants Bureau, 1965.
- Hagedorn P. Nichtlineare Schwingungen. Akademische Verlagsgesellschaft, 1978.
- Thomsen J.J. Vibration and Stability, Order and Chaos. McGraw-Hill, 1997.

T 11.396 Course: Thermal Solar Energy [T-MACH-105225]

Responsible: Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102648 - Major Field: Energy Technology for Buildings

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2169472	Thermal Solar Energy	2 SWS	Lecture (V)	Stieglitz
Exams					
SS 2019	76-T-MACH-105225	Thermal Solar Energy		Prüfung (PR)	Stieglitz
WS 19/20	76-T-MACH-105225	Thermal Solar Energy		Prüfung (PR)	Stieglitz

Competence Certificate
Oral examination, 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Thermal Solar Energy
Lecture (V)
2169472, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

Basics of thermal solar energy (radiation, heat conduction, storage, efficiency...) Active and passive use of solar energy. Solar collectors (design types, efficiency, system technology). Solar plants (heliostats etc.). Solar climatisation.

In detail:

1 Introduction to energy requirements and evaluation of the potential use of solar thermal energy.

2 Primary energy source SUN: sun, solar constant, radiation (direct, diffuse scattering, absorption, impact angle, radiation balance).

3 Solar collectors: schematic structure of a collector, fundamentals of efficiency, meaning of concentration and their limitations.

4 Passive solar mechanisms: heat conduction in solids and gases, radiation heat transfer in transparent and opaque bodies, selective absorber - typical materials and manufacturing processes.

5 Momentum and heat transport: basic equations of single and multiphase transport, calculation methods, stability limits.

optional

6 Low temperature solar thermal systems: collector types, methods for system simulation, planning and dimensioning of systems, system design and stagnation scenarios.

7 High temperature solar thermal systems: solar towers and solar-farm concept, loss mechanisms, chimney power plants and energy production processes

The lecture elaborates the basics of the solar technology and the definition of the major wordings and its physical content such as radiation, thermal use, insulation etc.. Further the design of solar collectors for different purposes is discussed and analyzed. The functional principle of solar plants is elaborated before at the end the ways for solar cooling is discussed.

The aim of the course is to provide the basic physical principles and the derivation of key parameters for the individual solar thermal use. This involves in addition to the selective absorber, mirrors, glasses, and storage technology. In addition, a utilization of solar thermal energy means an interlink of the collector with a thermal-hydraulic circuit and a storage. The goal is to capture the regularities of linking to derive efficiency correlations as a function of their use and evaluate the performance of the entire system.

Recommendations / previous knowledge

Basics in heat and mass transfer, material science and fluid mechanics, desirable are reliable knowledge in physics in optics and thermodynamics

Oral exam of about 25 minutes, no tools or reference materials may be used during the exam

Learning Content

Baiscs of thermal solar energy (radiation, heat conduction, storage, efficiency ....) Active and passive use of solar energy. Solar collectors (design types, efficiency, system technology). Solar plants (heliostats etc.). Solar climatization.

In detail:

1 Introduction to energy requirements and evaluation of the potential use of solar thermal energy.

2 Primary energy sources SUN: sun, solar constant, radiation (direct, diffuse scattering, absorption, impact angle, radiation balance).

3 Solar panels: schematic structure of a collector, fundamentals of efficiency, meaning of concentration and their limitations.

4 Passive solar mechanisms: heat conduction in solids and gases, radiation heat transfer in transparent and opaque bodies, selective absorber - typical materials and manufacturing processes.

5 Momentum and heat transport: basic equations of single and multiphase transport, calculation methods, stability limits.

optional

6 Low temperature solar thermal systems: Collector variants, methods for system simulation, planning and dimensioning of systems, system design and arrest scenarios.

6 High temperature solar thermal systems: solar towers and solar-farm concept, loss mechanisms, chimney power plants and energy production processes

end

- Memory: energy content, storage types, storage materials, cost
- Solar Air Conditioning: Cooling capacity determination, climate, solar cooling method and evaluation of air conditioning.

Workload
regular attendance: 21 h
self-study: 90 h

Literature
supply of lecture material in printed and electronic form

Stieglitz & Heinzel; Thermische Solarenergie -Grundlagen-Technologie- Anwendungen. Springer Vieweg Verlag. 711 Seiten. ISBN 978-3-642-29474-7

T 11.397 Course: Thermal Turbomachines I [T-MACH-105363]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102635 - Major Field: Engineering Thermodynamics
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	2169453	Thermal Turbomachines I	3 SWS	Lecture / Practice (VÜ)	Bauer
WS 19/20	2169454	Tutorial - Thermal Turbo Machines I (Übungen zu Thermische Turbomaschinen I)	2 SWS	Practice (Ü)	Bauer
WS 19/20	2169553	Thermal Turbomachines I (in English)	3 SWS	Lecture / Practice (VÜ)	Bauer
Exams					
SS 2019	76-T-MACH-105363	Thermal Turbomachines I		Prüfung (PR)	Bauer

Competence Certificate
oral exam, duration 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Thermal Turbomachines I

2169453, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Learning Content
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

Workload
regular attendance: 31,50 h
self-study: 64,40 h

Literature
Lecture notes (available via Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

V **Thermal Turbomachines I (in English)** **Lecture / Practice (VÜ)**
2169553, WS 19/20, 3 SWS, Language: English, Open in study portal

Learning Content
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

Workload
regular attendance: 31,50 h
self-study: 64,40 h

Literature
Lecture notes (available via Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

T 11.398 Course: Thermal Turbomachines II [T-MACH-105364]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102635 - Major Field: Engineering Thermodynamics
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	2

Events					
SS 2019	2170476	Thermal Turbomachines II	3 SWS	Lecture (V)	Bauer
SS 2019	2170477	Tutorial - Thermal Turbomachines II (Übung - Thermische Turbomaschinen II)	2 SWS	Practice (Ü)	Bauer, Mitarbeiter
SS 2019	2170553	Thermal Turbomachines II (in English)	3 SWS	Lecture / Practice (VÜ)	Bauer, Mitarbeiter
Exams					
SS 2019	76-T-MACH-105364	Thermal Turbomachines II		Prüfung (PR)	Bauer

Competence Certificate
oral exam, duration: 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Thermal Turbomachines II
2170476, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
General overview, trends in design and development

Comparison turbine - compressor

Integrating resume of losses

Principal equations and correlations in turbine and compressor design, stage performance

Off-design performance of multi-stage turbomachines

Control system considerations for steam and gas turbines

Components of turbomachines

Critical components

Materials for turbine blades

Cooling methods for turbine blades (steam and air cooling methods)

Short overview of power plant operation

Combustion chamber and environmental issues

Workload
regular attendance: 31,50 h
self-study: 64,40 h

Literature
Lecture notes (Available via internet)
Bohl, W.: Strömungsmaschinen, Bd. I,II, Vogel Verlag 1990, 1991
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993
Traupel, W.: Thermische Turbomaschinen, Bd. I,II, Springer-Verlag, 1977, 1982

V **Thermal Turbomachines II (in English)** **Lecture / Practice (VÜ)**
2170553, SS 2019, 3 SWS, Language: English, Open in study portal

Learning Content
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

Workload
regular attendance: 31,50 h
self-study: 64,40 h

Literature
Lecture notes (available via Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

T 11.399 Course: Thermal-Fluid-Dynamics [T-MACH-106372]

Responsible: Dr. Sebastian Ruck
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102634 - Major Field: Fluid Mechanic
M-MACH-102643 - Major Field: Fusion Technology
M-MACH-102648 - Major Field: Energy Technology for Buildings

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189423	Thermal-Fluid-Dynamics	2 SWS	Lecture (V)	Ruck
Exams					
SS 2019	76-T-MACH-106372	Thermal-Fluid-Dynamics		Prüfung (PR)	Ruck, Stieglitz
WS 19/20	76-T-MACH-106372	Thermal-Fluid-Dynamics		Prüfung (PR)	Ruck, Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Thermal-Fluid-Dynamics
2189423, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Main Issues

- Fundamentals of flows and heat transfer
- Dimensionless parameters of thermal fluid dynamics
- Statistic description and analytics of turbulent flows
- Thermal boundary layer equations
- Velocity and temperature laws in boundary layers
- Convective Heat transfer of external and internal flows
- Analogies (Prandtl-, von Kárman, Martinelli,...)
- Methods for enhancing heat transfer
- Strategies and methods for experimental and numerical investigation of thermal-hydraulics in R&D

Notes

Content

- Fundamentals of flows and heat transfer
- Dimensionless parameters of thermal fluid dynamics
- Laminar and turbulent thermal boundary layer equations
- Velocity and temperature laws in boundary layers
- Convective heat transfer of external and internal flows
- Heat transfer analogies (Prandtl-, von Kárman, Martinelli,...)
- Methods for enhancing heat transfer
- Strategies and methods for investigation of thermal-hydraulics in R&D

The lecture provides an overview of momentum and energy transport as occurring in power engineering components and heat exchangers. On the basis of the conservation equations and the fundamentals of thermal-hydraulics, dimensionless parameters for forced and free convection are evolved. Flows close to walls play a crucial role for the convective heat transfer and for heat exchanger components. Thus, with scaling rules the laminar and turbulent thermal boundary layer equations are introduced. In the following, velocity and temperature laws of the wall as a basis for analogies and models of computational tools are discussed and the influence of roughness and surface design are shown. Concepts of state-of-the-art turbulence modelling and their applicability for different conditions or different heat transfer fluids (e.g. liquid metals, gas, oil) are described. Analogies and correlations for internal and external forced convection are developed by means of approximation concepts. Design options to enhance the efficiency and effectiveness of heat exchangers are discussed.

The objectives of the lecture are the fundamentals of thermal-hydraulics for describing and modelling convective fluid flow as occurring in power engineering components. A major objective is the description of the convective heat transfer for external and internal flows. A key issue is the transfer of analytic models and empirical results into “state of the art” computational tools and their validation by advanced experimental methods. Within the scope of the course, the students learn (a) to develop differential equation for thermal-hydraulic problems and to describe the thermal flow field by means of dimensionless parameters, (b) to transfer a real problem to an experiment or computational model, (c) to develop analogies and correlations for heat transfer processes of forced convection, (d) to select adequate computational methods/models, (e) to evaluate and select experiments including measurement techniques with adequate instrumentation for thermal-hydraulic problems and (f) to know design option for an efficient and effective heat exchange.

Attendance time: 21 h
Preparation/follow-up time of lectures, exam preparation: 90h

Oral exam of about 30 min.

Learning Content

The lecture provides an overview of momentum and energy transport as occurring in power engineering components and heat exchangers. Conservation equations are discussed. Based on the fundamentals of thermal-hydraulics, dimensionless parameters for forced and free convection are evolved. The statistical concepts for describing turbulent flows and the corresponding transport equations are introduced. Analysis of thermal and turbulent measurement signals are discussed.

Flows close to walls play a crucial role for the convective heat transfer and for heat exchanger components. Thus, the thermal boundary layer equations are introduced for the laminar and turbulent case. Velocity and temperature laws of the wall as a basis for analogies and models of computational tools are discussed; turbulence modelling and scale-resolving methods and their applicability for different conditions or heat transfer fluids are described in the following. Analogies and correlations for internal and external forced convection are developed by means of approximation concepts. Furthermore, design options to enhance the efficiency of heat exchangers are discussed.

Solution strategies and best practical guidelines of the aforementioned methods are provided.

Workload

Attendance time: 21 h

Preparation/follow-up time of lectures, exam preparation: 90h

Literature

Literature are specified in the corresponding lectures. Teaching materials are provided online at **http://ilias.studium.kit.edu**. Hardcopy script for special topics during the lecture.

T 11.400 Course: Thin Film and Small-scale Mechanical Behavior [T-MACH-105554]

Responsible: Dr. Patric Gruber
Dr. Ruth Schwaiger
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102649 - Major Field: Advanced Materials Modelling

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2178123	Thin film and small-scale mechanical behavior	2 SWS	Lecture (V)	Weygand, Gruber
Exams					
SS 2019	76-T-MACH-105554	Thin Film and Small-scale Mechanical Behavior		Prüfung (PR)	Gruber, Weygand

Competence Certificate
oral exam 30 minutes

Prerequisites
none

Recommendation
preliminary knowlegde in materials science, physics and mathematics

T 11.401 Course: Tires and Wheel Development for Passenger Cars [T-MACH-102207]

Responsible: Dr.-Ing. Günter Leister
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114845	Tires and Wheel Development for Passenger Cars	2 SWS	Lecture (V)	Leister
Exams					
SS 2019	76-T-MACH-102207	Tires and Wheel Development for Passenger Cars		Prüfung (PR)	Leister

Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Tires and Wheel Development for Passenger Cars
2114845, SS 2019, 2 SWS, Open in study portal

Lecture (V)

Learning Content

1. The role of the tires and wheels in a vehicle
2. Geometrie of Wheel and tire, Package, load capacity and endurance, Book of requirement
3. Mobility strategy, Minispare, runflat systems and repair kit.
4. Project management: Costs, weight, planning, documentation
5. Tire testing and tire properties
6. Wheel technology incuding Design and manifacturing methods, Wheeltesting
7. Tire presssure: Indirect and direct measuring systems
8. Tire testing subjective and objective

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
Manuscript to the lecture

T 11.402 Course: Tractors [T-MACH-105423]

Responsible: Simon Becker
Prof. Dr.-Ing. Marcus Geimer
Hon.-Prof. Dr. Martin Kremmer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102630 - Major Field: Mobile Machines

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2113080	Tractors	2 SWS		Kremmer, Becker
Exams					
WS 19/20	76-T-MACH-105423	Tractors		Prüfung (PR)	Geimer

Competence Certificate
The assessment consists of an written exam taking place in the recess period (90 min).

Prerequisites
none

Recommendation
Basic knowledge in mechanical engineering.

Annotation

Learning Outcomes

After completion of the course the Students know:

- important problems in agritechnological developments
- Customer requirements and their implementation in tractors
- Tractor technology in width and depth

Content

Tractors are one of the most underestimated vehicles in regard to performance und technics. Almost none vehicle is as multifunctional and fulfilled with high-tech as a tractor. Automatic guidance, special chassis suspension or special concepts of power trains are one of the topics where tractors are in leading position in technologies
During the lecture an overview about the design and construction and application area is given. A close look will be taken on the historical background, legal requirements, ways of development, agricultural organizations and the process of development itself.
In detail the following topics will be dealt with:

- agricultural organization / legal requirements
- history of tractors
- tractor engineering
- tractor mechanics
- chassis suspension
- combustion engine
- transmission
- interfaces
- hydraulics
- wheels and tyres
- cabin
- electrics and electronics

Literature

- K.T. Renius: Traktoren - Technik und ihre Anwendung; DLG Verlag (Frankfurt), 1985
- E. Schilling: Landmaschinen - Lehr- und Handbuch für den Landmaschinenbau; Schilling-Verlag (Köln), 1960

Below you will find excerpts from events related to this course:

V **Tractors**
2113080, WS 19/20, 2 SWS, Language: German, **Open in study portal**

Learning Content
Tractors are one of the most underestimated vehicles in regard to performance und technics. Almost none vehicle is as multifunctional and fullfilled with high-tec as a tractor. Automatic guidance, special chassis suspension or special concepts of power trains are one of the topics where tractors are in leading position in technologies

During the lecture an overview about the design and construction and application area is given. A close look will be taken on the historical backround, legal requirements, ways of development, agricultural organizations and the proces of development itself.

In detail the following topics will be dealt with:

- agricultural organization / legal requirements
- history of tractors
- tractor engineering
- tractor mechanics
- chassis suspension
- combustion engine
- transmission
- interfaces
- hydraulics
- wheels and tyres
- cabin
- electrics and electronics

Workload

- regular attendance: 21 hours
- self-study: 92 hours

Literature

- K.T. Renius: Traktoren - Technik und ihre Anwendung; DLG Verlag (Frankfurt), 1985
- E. Schilling: Landmaschinen - Lehr- und Handbuch für den Landmaschinenbau; Schilling-Verlag (Köln), 1960

T 11.403 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-102599 - Major Field: Powertrain Systems
M-MACH-102637 - Major Field: Tribology
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains

Type	Credits	Recurrence	Version
Oral examination	8	Each winter term	2

Events					
WS 19/20	2181114	Tribology	5 SWS	Lecture / Practice (VÜ)	Dienwiebel, Scherge
Exams					
SS 2019	76-T-MACH-105531	Tribology		Prüfung (PR)	Dienwiebel

Competence Certificate
oral examination (ca. 40 min)

no tools or reference materials

Prerequisites
admission to the exam only with successful completion of the exercises [T-MACH-109303]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-109303 - Exercices - Tribology must have been passed.

Recommendation
preliminary knowlegde in mathematics, mechanics and materials science

Below you will find excerpts from events related to this course:

V Tribology

2181114, WS 19/20, 5 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, evironmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems
- evaluate the friction and wear behavior of tribological systems
- explain the effects of lubricants and their most important additives
- identify suitable approaches to optimize tribological systems
- explain the most important experimental methods for the measurement of friction and wear, and is able to use them for the characterisation of tribo pairs
- choose suitable methods for the evaluation of roughness and topography from the nm-scale to the mm-scale and is able to interpret the determined values in respect to their effect on the tribological behavior
- describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces

preliminary knowlegde in mathematics, mechanics and materials science recommended

regular attendance: 45 hours
self-study: 195 hours

oral examination (ca. 40 min)

no tools or reference materials

admission to the exam only with successful completion of the exercises

Learning Content

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, evironmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

Workload
regular attendance: 45 hours
self-study: 195 hours

Literature

1. Fleischer, G. ; Gröger, H. ; Thum: Verschleiß und Zuverlässigkeit. 1. Auflage. Berlin : VEB-Verlag Technik, 1980
2. Persson, B.J.N.: Sliding Friction, Springer Verlag Berlin, 1998
3. M. Dienwiebel, and M. Scherge, Nanotribology in automotive industry, In:Fundamentals of Friction and Wear on the Nanoscale; Editors: E. Meyer and E. Gnecco, Springer, Berlin, 2007.
4. Scherge, M., Shakhvorostov, D., Pöhlmann, K.: Fundamental wear mechanism of metals. Wear 255, 395–400 (2003)
5. Shakhvorostov, D., Pöhlmann, K., Scherge, M.: An energetic approach to friction, wear and temperature. Wear 257, 124–130 (2004)

T 11.404 Course: Turbine and Compressor Design [T-MACH-105365]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2169462	Turbine and compressor Design	2 SWS	Lecture (V)	Bauer
Exams					
SS 2019	76-T-MACH-105365	Turbine and Compressor Design		Prüfung (PR)	Schulz, Bauer

Competence Certificate
oral exam, duration: 20 min.

Prerequisites
Exams Thermal Turbomachinery I & II successfully passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105363 - Thermal Turbomachines I must have been passed.
2. The course T-MACH-105364 - Thermal Turbomachines II must have been passed.

Below you will find excerpts from events related to this course:

V Turbine and compressor Design
2169462, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
The lecture is intended to expand the knowledge from Thermal Turbomachines I+II.
Thermal Turbomaschines, general overview

Design of a turbomachine: Criteria and development

Radial machines

Transonic compressors

Combustion chambers

Multi-spool installations

Workload
regular attendance: 21 h
self-study: 42 h

Literature

Münzberg, H.G.: Gasturbinen - Betriebsverhalten und Optimierung, Springer Verlag, 1977

Traupel, W.: Thermische Turbomaschinen, Bd. I-II, Springer Verlang, 1977, 1982

T 11.405 Course: Turbo Jet Engines [T-MACH-105366]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2170478	Turbo Jet Engines	2 SWS	Lecture (V)	Bauer, Mitarbeiter
Exams					
SS 2019	00003	Turbo Jet Engines		Prüfung (PR)	Bauer
SS 2019	76-T-MACH-105366	Turbo Jet Engines		Prüfung (PR)	Bauer, Schulz

Competence Certificate
oral exam, duration: 20 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Turbo Jet Engines

2170478, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning 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

Workload
regular attendance:21 h
self-study: 42 h

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 11.406 Course: Tutorial Continuum Mechanics of solids and fluids [T-MACH-110333]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Prof. Dr.-Ing. Bettina Frohnapfel

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	1	Each winter term	1

Events					
WS 19/20	2161253	Tutorial Continuum mechanics of solids and fluids	1 SWS	Practice (Ü)	Dyck, Böhlke

Competence Certificate
Successfully passing the Tutorial is a prerequisite for taking part in the exam "Continuum Mechanics of Solids and Fluids" (T-MACH-110377)

For students of Mechanical Engineering (Bachelor) 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 using the commercial Finite Element Program Abaqus.during the associated Lab Course.

For students of Mechanical Engineering (Bachelor) that have chosen a different Major Field of students from different fields of study the prerequisites consist of successfully solving only the written homework sheets. For organizational matters these students can not take part into the Lab Course.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Tutorial Continuum mechanics of solids and fluids

Practice (Ü)

2161253, WS 19/20, 1 SWS, Language: German, Open in study portal

Notes
Please refer to the lecture "Continuum mechanics of solids and fluids".

Learning Content
see Tutorial Continuum mechanics of solids and fluids

Literature
see Tutorial Continuum mechanics of solids and fluids

T 11.407 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-102628 - Major Field: Lightweight Construction

Type	Credits	Recurrence	Version
Completed coursework	1	Each summer term	1

Events					
SS 2019	2162257	Tutorial "Introduction to the Finite Element Method"	1 SWS	Practice (Ü)	Langhoff, Böhlke

Competence Certificate
Depening on the field of study, attestations have to be achieved in the following categories: written homework problems and computational homework problems

This course is passed if in total at most two attestations have finally not been passed

Successful participation in this course allows for registration to the Exam "Introduction to the Finite Element Method" (see 76-T-MACH-105320)

Annotation
Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected.

The assignment of the restricted places in the Lab Course is crucial to the institute.

Below you will find excerpts from events related to this course:

V Tutorial "Introduction to the Finite Element Method"

Practice (Ü)

2162257, SS 2019, 1 SWS, Language: German, Open in study portal

Notes
See lecture "Introduction to the Finite Element Method"

T 11.408 Course: Tutorial Mathematical Methods in Continuum Mechanics [T-MACH-110376]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-102594 - Mathematical Methods
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Expansion	Version
Completed coursework	1	Each winter term	1 terms	1

Events					
WS 19/20	2161255	Tutorial Mathematical Methods in Confinuum Mechanics	2 SWS	Practice (Ü)	Wicht, Böhlke
Exams					
WS 19/20	76-T-MACH-110376	Tutorial Mathematical Methods in Continuum Mechanics		Prüfung (PR)	Böhlke

Competence Certificate
successfully solving the homework sheets. Details are announced in the first lecture.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Tutorial Mathematical Methods in Confinuum Mechanics
Practice (Ü)
2161255, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
See "Mathematical Methods in Continuum Mechanics"

T 11.409 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-102594 - Mathematical Methods
M-MACH-102602 - Major Field: Reliability in Mechanical Engineering
M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	1	Each summer term	1

Competence Certificate
Successfully solving the homework sheets. Details are given in the first lecture.

T 11.410 Course: Tutorial Mathematical Methods in Strength of Materials [T-MACH-106830]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology

Type	Credits	Recurrence	Version
Completed coursework	1	Each winter term	3

Competence Certificate
successfully solving the homework sheets. Details are announced in the first lecture.

Prerequisites
None

T 11.411 Course: Tutorial Mathematical Methods in Structural Mechanics [T-MACH-106831]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction

Type	Credits	Recurrence	Version
Completed coursework	1	Each summer term	2

Events					
SS 2019	2162281	Tutorial "Mathematical Methods in Micromechanics"	1 SWS	Practice (Ü)	N.N., Böhlke
Exams					
SS 2019	76-T-MACH-106831	Tutorial Mathematical Methods in Structural Mechanics		Prüfung (PR)	Böhlke

Competence Certificate
Successfully solving the homework sheets. Details are given in the first lecture.

Prerequisites
none

T 11.412 Course: Two-Phase Flow and Heat Transfer [T-MACH-105406]

Responsible: Prof. Dr.-Ing. Thomas Schulenberg
Dr. Martin Wörner

Organisation: KIT Department of Chemical and Process Engineering
KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102608 - Major Field: Nuclear Energy
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102634 - Major Field: Fluid Mechanic
M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Version
Oral examination	4	1

Events					
WS 19/20	2169470	Two-Phase Flow and Heat Transfer	2 SWS	Lecture (V)	Wörner, Schulenberg

Competence Certificate
oral exam, duration: approximately 30 minutes

no tools or reference materials may be used during the exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Two-Phase Flow and Heat Transfer

2169470, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Power Point presentations

Excel analyses

Notes
The students can describe two-phase flows with heat transfer as phenomena occuring in steam generators and condensers (e.g. in power stations or refrigerators). They can distinguish different flow regimes and transitions and apply two-phase flow models. The students are qualified to explain the characteristics of different flow examples (e.g. pressure drop of two phase flows, pool boiling, forced convective boiling, condensation) and can analysze two-phase flow instabilities.

- Examples for technical applications
- Definitions and averaging of two-phase flows
- Flow regimes and transitions
- Two-phase models
- Pressure drop of two phase flows
- Pool boiling
- Forced convective boiling
- Condensation
- Two-phase flow instabilities

Learning Content

- Examples for technical applications
- Definitions and averaging of two-phase flows
- Flow regimes and transitions
- Two-phase models
- Pressure drop of two phase flows
- Pool boiling
- Forced convective boiling
- Condensation
- Two-phase flow instabilities

Annotation
Recommendations: Basics of fluid mechanics and thermodynamics are a mandatory requirement.

Workload
regular attendance: 21 h
self-study: 99 h

Literature
lecture notes

T 11.413 Course: Vacuum and Tritium Technology in Nuclear Fusion [T-MACH-108784]

Responsible: Dr. Beate Bornschein
Dr. Christian Day

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102643 - Major Field: Fusion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190499	Vacuum and Tritium Technology in Nuclear Fusion	2 SWS		Day, Größle
Exams					
SS 2019	76-T-MACH-108784	Vacuum and Tritium Technology in Nuclear Fusion		Prüfung (PR)	Day, Bornschein

Competence Certificate
oral examination, 20 Minutes, any time in the year

Prerequisites
none

Recommendation
Knowledge in ´Fusion Technology A´

Below you will find excerpts from events related to this course:

V Vacuum and Tritium Technology in Nuclear Fusion
2190499, SS 2019, 2 SWS, Language: German/English, Open in study portal

Notes
Introduction

Tritium Handling

Tritium Plant Technologies

Tritium and Breeding

Fundamentals of Vacuum Science and Technology

Fusion Vacuum systems

Matter Injection into the Plasma Chamber

Fuel Cycle of ITER and DEMO

The students have acquired the necessary understanding in order to design and size facilities for tritium operation. They understand the process steps in the tritium plant of a fusion reactor for tritium removal and tritium recovery from tritiated exhaust gas. Furthermore, the students have understood the fundamentals of vacuum physics and are able to design and choose vacuum pumps properly.

recommended is Knowledge in "Fusion Technology A"

oral exam of about 20 min

Learning Content

Introduction

Tritium Handling

Tritium Plant Technologies

Tritium and Breeding

Fundamentals of Vacuum Science and Technology

Fusion Vacuum systems

Matter Injection into the Plasma Chamber

Fuel Cycle of ITER and DEMO

T 11.414 Course: Value stream within enterprises – The value chain at Bosch [T-MACH-106375]

Responsible: Dr. Rudolf Maier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102824 - Key Competences

Type	Credits	Recurrence	Version
Completed coursework	2	Each winter term	1

Events					
WS 19/20	2149661	The value stream in an industrial company - The value chain at BOSCH as an example	2 SWS	Seminar (S)	Maier
Exams					
SS 2019	76-T-MACH-106375	Value stream within enterprises – The value chain at Bosch		Prüfung (PR)	Maier

Competence Certificate
alternative achievement (ungraded):
- attendance on at least 12 lecture units

Prerequisites
none

Below you will find excerpts from events related to this course:

V The value stream in an industrial company - The value chain at BOSCH as an example

Seminar (S)

2149661, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Lecture notes will be provided in Ilias
(https://ilias.studium.kit.edu/)

Notes

The seminar provides an insight into the main functional units of a company and their typical processes by using Bosch as an example. Furthermore it is based on discussions with the students. Former Bosch top managers explain the essential business processes and functions of the individual departments as well as the classic tasks of an engineer in a worldwide operating automotive supplier. The seminar also provides an insight into the careers of the Bosch directors. In addition to the company processes, the seminar will therefore focus on reports of challenges, successes, failures and product and process innovations.

The topics are as follows:

- Introduction, strategy, innovation
- R&D, product development process
- Production
- Quality management
- Market, marketing, sales
- Aftermarket, service
- Finance, controlling
- Logistics
- Purchasing, supply chain
- IT
- HR, leadership, compliance

Learning Outcomes:

The students ...

- are able to deduce, understand and assess the structure of a global operating enterprise.
- are capable to identify and compare the work flows and processes within a global operating enterprise.
- are able to recognize and assess the problems within interfaces between functional and organizational units which are identified by the experts. Furthermore the students can develop solutions based on this knowledge in order to overcome these problems.

Workload:

regular attendance: 21 hours
self-study: 39 hours

Learning Content

The seminar provides an insight into the main functional units of a company and their typical processes by using Bosch as an example. Furthermore it is based on discussions with the students. Former Bosch top managers explain the essential business processes and functions of the individual departments as well as the classic tasks of an engineer in a worldwide operating automotive supplier. The seminar also provides an insight into the careers of the Bosch directors. In addition to the company processes, the seminar will therefore focus on reports of challenges, successes, failures and product and process innovations.
The topics are as follows:

- Introduction, strategy, innovation
- R&D, product development process
- Production
- Quality management
- Market, marketing, sales
- Aftermarket, service
- Finance, controlling
- Logistics
- Purchasing, supply chain
- IT
- HR, leadership, compliance

Workload

regular attendance: 21 hours
self-study: 39 hours

T 11.415 Course: Vehicle Comfort and Acoustics I [T-MACH-105154]

Responsible: Prof. Dr. Frank Gauterin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
SS 2019	2114856	Vehicle Ride Comfort & Acoustics I	2 SWS	Lecture (V)	Gauterin
WS 19/20	2113806	Vehicle Comfort and Acoustics I	2 SWS	Lecture (V)	Gauterin
Exams					
SS 2019	76-T-MACH-105154	Vehicle Comfort and Acoustics I		Prüfung (PR)	Gauterin
SS 2019	76T-Mach-105154_1	Vehicle Comfort and Acoustics I		Prüfung (PR)	Gauterin

Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
Can not be combined with lecture T-MACH-102206

Below you will find excerpts from events related to this course:

V Vehicle Ride Comfort & Acoustics I

2114856, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes
In English language.

Learning Content
1. Perception of noise and vibrations

3. Fundamentals of acoustics and vibrations

3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations

4. The relevance of tire and chasis for the acoustic and mechanical driving comfort:
phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
1. Michael Möser, Technische Akustik, Springer, Berlin, 2005

2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

3. Manfred Mitschke, Dynamik der Kraftfahrzeuge, Band B: Schwingungen, Springer, Berlin, 1997

The script will be supplied in the lectures

V Vehicle Comfort and Acoustics I

2113806, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. Perception of noise and vibrations

3. Fundamentals of acoustics and vibrations

3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations

4. The relevance of tire and chasis for the acoustic and mechanical driving comfort:
phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
1. Michael Möser, Technische Akustik, Springer, Berlin, 2005

2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

3. Manfred Mitschke, Dynamik der Kraftfahrzeuge, Band B: Schwingungen, Springer, Berlin, 1997

The script will be supplied in the lectures

T 11.416 Course: Vehicle Comfort and Acoustics II [T-MACH-105155]

Responsible: Prof. Dr. Frank Gauterin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102650 - Major Field: Combustion Engines Based Powertrains
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114825	Vehicle Comfort and Acoustics II	2 SWS	Lecture (V)	Gauterin
SS 2019	2114857	Vehicle Ride Comfort & Acoustics II	2 SWS	Lecture (V)	Gauterin
Exams					
SS 2019	76-T-MACH-105155	Vehicle Comfort and Acoustics II		Prüfung (PR)	Gauterin

Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
Can not be combined with lecture T-MACH-102205

Below you will find excerpts from events related to this course:

V Vehicle Comfort and Acoustics II
2114825, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. Summary of the fundamentals of acoustics and vibrations

2. The relevance of road surface, wheel imperfections, springs, dampers, brakes, bearings and bushings, suspensions, engines and drive train for the acoustic and mechanical driving comfort:
- phenomena
- influencing parameters
- types of construction
- optimization of components and systems
- conflicts of goals
- methods of development

3. Noise emission of motor vehicles
- noise stress
- sound sources and influencing parameters
- legal restraints
- optimization of components and systems
- conflict of goals
- methods of development

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
The script will be supplied in the lectures.

V **Vehicle Ride Comfort & Acoustics II** **Lecture (V)**
2114857, SS 2019, 2 SWS, Language: English, Open in study portal

Notes
The lecture starts in June 2016. Exact date of beginning: see homepage of institute.

In English language.

Learning Content
1. Summary of the fundamentals of acoustics and vibrations

2. The relevance of road surface, wheel imperfections, springs, dampers, brakes, bearings and bushings, suspensions, engines and drive train for the acoustic and mechanical driving comfort:
- phenomena
- influencing parameters
- types of construction
- optimization of components and systems
- conflicts of goals
- methods of development

3. Noise emission of motor vehicles
- noise stress
- sound sources and influencing parameters
- legal restraints
- optimization of components and systems
- conflict of goals
- methods of development

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
The script will be supplied in the lectures.

T 11.417 Course: Vehicle Ergonomics [T-MACH-108374]

Responsible: Dr.-Ing. Tobias Heine
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102600 - Major Field: Man - Technology - Organisation
M-MACH-102605 - Major Field: Engineering Design
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102630 - Major Field: Mobile Machines

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2110050	Vehicle Ergonomics	2 SWS	Lecture (V)	Heine
Exams					
SS 2019	76-T-MACH-108374	Vehicle Ergonomics		Prüfung (PR)	Deml

Competence Certificate
written exam, 60 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Vehicle Ergonomics
2110050, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
- Basics of physical-body related ergonomics
- Basics of cognitive ergonomics
- Theories of driver behaviour
- interface design
- usability testing

Learning objective:

An ergonomic vehicle is best adapted to the requirements, needs and characteristics of its users, thus enabling effective, efficient and satisfactory interaction. After attending the lecture, students will be able to analyse and evaluate the ergonomic quality of various vehicle concepts and derive design recommendations. They can consider aspects of both physical-body and cognitive ergonomics. The students are familiar with basic ergonomic methods, theories and concepts as well as with theories of human information processing, especially driver behaviour. They are able to discuss this knowledge critically and to apply it flexibly within the framework of the user-oriented design process.

Translated with www.DeepL.com/Translator

T 11.418 Course: Vehicle Lightweight Design - Strategies, Concepts, Materials [T-MACH-105237]

Responsible: Prof. Dr.-Ing. Frank Henning
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102607 - Major Field: Vehicle Technology
M-MACH-102628 - Major Field: Lightweight Construction
M-MACH-102632 - Major Field: Polymer Engineering
M-MACH-102641 - Major Field: Rail System Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2113102	Vehicle Lightweight design – Strategies, Concepts, Materials	2 SWS	Lecture (V)	Henning
Exams					
SS 2019	76-T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials		Prüfung (PR)	Henning

Competence Certificate
Written exam, 90 minutes

Prerequisites
none

Recommendation
none

Below you will find excerpts from events related to this course:

V Vehicle Lightweight design – Strategies, Concepts, Materials

Lecture (V)

2113102, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
strategies in lightweight design
shape optimization, light weight materials, multi-materials and concepts for lightweight design

construction methods
differential, integral, sandwich, modular, bionic

body construction
shell, space frame, monocoque

metalic materials
steal, aluminium, magnesium, titan

Workload
lectures: 21h, preparation of examination: 79h

T 11.419 Course: Vehicle Mechatronics I [T-MACH-105156]

Responsible: Prof. Dr.-Ing. Dieter Ammon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-102607 - Major Field: Vehicle Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Competence Certificate
Written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

T 11.420 Course: Vibration Theory [T-MACH-105290]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Prof. Dr.-Ing. Wolfgang Seemann

Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-102405 - Fundamentals and Methods of General Mechanical Engineering
M-MACH-102575 - Fundamentals and Methods of Energy and Environmental Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102636 - Major Field: Thermal Turbomachines
M-MACH-102646 - Major Field: Applied Mechanics
M-MACH-102739 - Fundamentals and Methods of Automotive Engineering
M-MACH-102740 - Fundamentals and Methods of Mechatronics and Microsystem Technology
M-MACH-102741 - Fundamentals and Methods of Product Development and Construction
M-MACH-102742 - Fundamentals and Methods of Production Technology
M-MACH-102743 - Fundamentals and Methods of Theoretical Foundations of Mechanical Engineering
M-MACH-102744 - Fundamentals and Methods of Materials and Structures for High Performance Systems
M-MACH-104434 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Written examination	5	Each winter term	2

Events					
WS 19/20	2161212	Vibration Theory	2 SWS	Lecture (V)	Fidlin, Römer
WS 19/20	2161213	Übungen zu Technische Schwingungslehre	2 SWS	Practice (Ü)	Fidlin, Römer, Burgert

Competence Certificate
written exam, 180 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Vibration Theory

Lecture (V)

2161212, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
Concept of vibration, superposition of vibration with equal and with different frequencies, complex frequency response.

Vibration of systems with one dof: Free undamped and damped vibration, forced vibration for harmonic, periodic and arbitrary excitation. Excitation of undamped vibration in resonance.

Systems with many degrees of freedom: Eigenvalue problem for undamped vibration, orthogonality of eigenvectors, modal decoupling, approximation methods, eigenvalue problem for damped vibration. Forced vibration for harmonic excitation, modal decomposition for arbitrary forced vibration, vibration absorber.

Vibration of systems with distributed parameters: Partial differential equations as equations of motion, wave propagation, d'Alembert's solution, Ansatz for separation of time and space, eigenvalue problem, infinite number of eigenvalues and eigenfunctions.

Introduction to rotor dynamics: Laval rotor in rigid and elastic bearings, inner damping, Laval rotor in anisotropic bearings, synchronous and asynchronous whirl, rotors with asymmetric shaft.

Workload
time of attendance: 22,5 h; self-study: 128 h

Literature
Klotter: Technische Schwingungslehre, Bd. 1 Teil A, Heidelberg, 1978

Hagedorn, Otterbein: Technische Schwingungslehre, Bd 1 and Bd 2, Berlin, 1987

Wittenburg: Schwingungslehre, Springer-Verlag, Berlin, 1995

T 11.421 Course: Virtual Engineering (Specific Topics) [T-MACH-105381]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	3122031	Virtual Engineering (Specific Topics)	2 SWS	Lecture (V)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-105381	Virtual Engineering (Specific Topics)		Prüfung (PR)	Ovtcharova

Competence Certificate
oral exam, 20 min.

Prerequisites
none

T 11.422 Course: Virtual Engineering I [T-MACH-102123]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102613 - Major Field: Lifecycle Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2121352	Virtual Engineering I	2 SWS	Lecture (V)	Ovtcharova
WS 19/20	2121353	Exercises Virtual Engineering I	2 SWS	Practice (Ü)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102123	Virtual Engineering I		Prüfung (PR)	Ovtcharova

Competence Certificate
Writen examination 90 min.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Virtual Engineering I — Lecture (V)
2121352, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Lecture notes

Learning Content
The lecture communicates IT aspects required for understanding virtual product development processes. For this purpose, the focus is set on systems used in industry supporting the process chain of Virtual Engineering:

- Product Lifecycle Management is an approach for managing product related data across the entire lifecycle of the product, beginning with the concept phase until disassembling and recycling.
- CAx-systems for virtual product development allow modeling digital products regarding design, construction, manufacturing and maintenance.
- Validation systems enable the analysis of products regarding statics, dynamics, safety and manufacturing feasibility.

The objective of the lecture is to clarify the relationship between construction and validation operations by applying virtual prototypes and VR/AR/MR visualization techniques in combination with PDM/PLM-systems. This is taught by introducing each particular system in applied exercises.

V Exercises Virtual Engineering I — Practice (Ü)
2121353, WS 19/20, 2 SWS, Language: German/English, Open in study portal

Learning Content
In this module, the practical application of different CAx software systems is exemplarily conducted in small groups, the main focus being the CAD systems CATIA V5 (DASSAULT SYSTEMES) and NX 5 (Siemens PLM Software).

Workload
Regular attendance: 31,5 hours, self-study: 10,5 hours

Literature
Exercise notes

T 11.423 Course: Virtual Engineering II [T-MACH-102124]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102613 - Major Field: Lifecycle Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2122378	Virtual Engineering II	2 SWS	Lecture (V)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102124	Virtual Engineering II		Prüfung (PR)	Ovtcharova

Competence Certificate
Writen examination 90 min.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Virtual Engineering II

2122378, SS 2019, 2 SWS, Language: German/English, Open in study portal

Lecture (V)

Description
Media:

Lecture notes

Learning Content
The lecture presents the IT aspects required for understanding virtual product development processes:

- Corresponding models can be visualized in Virtual Reality Systems, from individual parts to complete assembles.
- Virtual Prototypes combine CAD-data and information about properties of components and assemblies for immersive visualization, functionality tests and functional validation in VR/AR/MR environments.
- Integrated Virtual Product Development explains product development processes from the point of view of Virtual Engineering.

The objective of this lecture is to clarify the relationship between construction and validation operations by using virtual prototypes and VR/AR/MR visualization techniques in combination with PDM/PLM-systems. This will be achieved by introducing each particular IT-system with practical-oriented exercises.

T 11.424 Course: Virtual Engineering Lab [T-MACH-106740]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102613 - Major Field: Lifecycle Engineering

Type	Credits	Recurrence	Version
Examination of another type	4	Each term	1

Events					
SS 2019	2123350	Virtual Engineering Lab	SWS	Project (PRO)	Ovtcharova
WS 19/20	2123350	Virtual Engineering Lab	SWS	Project (PRO)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-106740	Virtual Engineering Lab		Prüfung (PR)	Ovtcharova

Competence Certificate
Assessment of another type (graded), procedure see webpage.

T 11.425 Course: Virtual Reality Practical Course [T-MACH-102149]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102601 - Major Field: Automation Technology
M-MACH-102612 - Major Field: Modeling and Simulation in Energy- and Fluid Engineering
M-MACH-102614 - Major Field: Mechatronics
M-MACH-102633 - Major Field: Robotics

Type	Credits	Recurrence	Version
Examination of another type	4	Each term	2

Events					
WS 19/20	2123375	Virtual Reality Practical Course	3 SWS	Project (PRO)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102149	Virtual Reality Practical Course		Prüfung (PR)	Ovtcharova

Competence Certificate
Assessment of another type (graded)

Prerequisites
None

Annotation
Number of participants is limited

Below you will find excerpts from events related to this course:

V Virtual Reality Practical Course

Project (PRO)

2123375, WS 19/20, 3 SWS, Language: German/English, Open in study portal

Learning Content
The lab course consists of:

1. Introduction and basics in virtual reality (hardware, software, application)
2. Introduction in 3DVIA Virtools tool kit as an application development system
3. IMplermentation and practice by developing a driving simulator in small groups.

T 11.426 Course: Virtual Training Factory 4.X [T-MACH-106741]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102613 - Major Field: Lifecycle Engineering

Type	Credits	Recurrence	Version
Examination of another type	4	Each term	1

Events					
SS 2019	2123351	Virtual training factory 4.X	SWS		Ovtcharova
WS 19/20	2123351	Virtual training factory 4.X	SWS		Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-106741	Virtual training factory 4.X		Prüfung (PR)	Ovtcharova

Competence Certificate
Assessment of another type (graded), procedure see webpage.

T 11.427 Course: Vortex Dynamics [T-MACH-105784]

Responsible: Dr. Jochen Kriegseis
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102634 - Major Field: Fluid Mechanic
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153438	Vortex Dynamics	2 SWS	Lecture (V)	Kriegseis
Exams					
SS 2019	76-T-MACH-105784	Vortex Dynamics		Prüfung (PR)	Kriegseis
WS 19/20	76-T-MACH-105784	Vortex Dynamics		Prüfung (PR)	Kriegseis

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Vortex Dynamics

Lecture (V)

2153438, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
The students can describe the physical basics and the mathematical description of vortex flows and are able to explaincharacteristic phenomena of vortex flows (e.g. vorticity, circulation and dissipation). They are qualified to analyze two- and three-dimensional vortex flows in steady and time-dependent form with respect to their structure and time-behaviour.

- Definition of a vortex
- Theoretical description of vortex flow
- Steady and time-dependent solutions of vortex flows
- Helmholtz's vortex theorems
- Vorticity equation
- Properties of various vortical structures
- Introduction of various vortec identification approaches

Learning Content

- Definition of a vortex
- Theoretical description of vortex flow
- Steady and time-dependent solutions of vortex flows
- Helmholtz's vortex theorems
- Vorticity equation
- Properties of various vortical structures
- Introduction of various vortec identification approaches

Workload
regulare attendance: 20h

Self-study: 100h

Literature

Spurk, J.H.: Fluid Mechanics, Springer, 1996

Green, S.I.: Fluid Vortices, Kluwer Academic Publishers, 1995

Wu, J.-Z. et al.: Vorticity and Vortex Dynamics, Springer, 2006

Saffman, P.G.: Vortex Dynamics, Cambrigde University Press, 1992

T 11.428 Course: Warehousing and Distribution Systems [T-MACH-105174]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102618 - Major Field: Production Technology
M-MACH-102625 - Major Field: Information Technology of Logistic Systems
M-MACH-102629 - Major Field: Logistics and Material Flow Theory
M-MACH-102640 - Major Field: Technical Logistics

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	2

Events					
SS 2019	2118097	Warehousing and distribution systems	2 SWS	Lecture (V)	Furmans
Exams					
SS 2019	76-T-MACH-105174	Warehousing and Distribution Systems		Prüfung (PR)	Furmans

Competence Certificate
The assessment consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

Prerequisites
none

Below you will find excerpts from events related to this course:

V Warehousing and distribution systems
2118097, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

presentations, black board

Learning Content

- Introduction
- Yard management
- Receiving
- Storage and picking
- Workshop on cycle times
- Consoldiation and packing
- Shipping
- Added Value
- Overhead
- Case Study: DCRM
- Planning of warehouses
- Case study: Planning of warehouses
- Distribution networks
- Lean Warehousing

Annotation
none

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature

ARNOLD, Dieter, FURMANS, Kai (2005)
Materialfluss in Logistiksystemen, 5. Auflage, Berlin: Springer-Verlag

ARNOLD, Dieter (Hrsg.) et al. (2008)
Handbuch Logistik, 3. Auflage, Berlin: Springer-Verlag

BARTHOLDI III, John J., HACKMAN, Steven T. (2008)
Warehouse Science

GUDEHUS, Timm (2005)
Logistik, 3. Auflage, Berlin: Springer-Verlag

FRAZELLE, Edward (2002)
World-class warehousing and material handling, McGraw-Hill

MARTIN, Heinrich (1999)
Praxiswissen Materialflußplanung: Transport, Hanshaben, Lagern, Kommissionieren, Braunschweig, Wiesbaden: Vieweg

WISSER, Jens (2009)
Der Prozess Lagern und Kommissionieren im Rahmen des Distribution Center Reference Model (DCRM); Karlsruhe : Universitätsverlag

A comprehensive overview of scientific papers can be found at:

ROODBERGEN, Kees Jan (2007)
Warehouse Literature

T 11.429 Course: Wave Propagation [T-MACH-105443]

Responsible: Prof. Dr.-Ing. Wolfgang Seemann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102598 - Major Field: Advanced Mechatronics
M-MACH-102601 - Major Field: Automation Technology
M-MACH-102606 - Major Field: Vehicle Dynamics, Vehicle Comfort and Acoustics
M-MACH-104443 - Major Field: Vibration Theory

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2161219	Wave Propagation	2 SWS	Lecture (V)	Seemann

Competence Certificate
oral exam, 30 min.

T 11.430 Course: Welding Technology [T-MACH-105170]

Responsible: Dr. Majid Farajian
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102611 - Major Field: Materials Science and Engineering
M-MACH-102618 - Major Field: Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2173571	Welding Technology	2 SWS	Lecture (V)	Farajian

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Basics of material science (iron- and non-iron alloys), materials, processes and production, design.

All the relevant books of the German Welding Institute (DVS: Deutscher Verband für Schweißen und verwandte Verfahren) in the field of welding and joining is recommended.

Below you will find excerpts from events related to this course:

V Welding Technology
2173571, WS 19/20, 2 SWS, Language: German, Open in study portal **Lecture (V)**

Notes

definition, application and differentiation: welding,

welding processes, alternative connecting technologies.

history of welding technology

sources of energy for welding processes

Survey: Fusion welding,

pressure welding.

weld seam preparation/design

welding positions

weldability

gas welding, thermal cutting, manual metal-arc welding

submerged arc welding

gas-shielded metal-arc welding, friction stir welding, laser beam and electron beam welding, other fusion and pressure welding processes

static and cyclic behavior of welded joints,

fatigue life improvement techniques

learning objectives:

The students have knowledge and understanding of the most important welding processes and its industrial application.

They are able to recognize, understand and handle problems occurring during the application of different welding processes relating to design, material and production.

They know the classification and the importance of welding technology within the scope of connecting processes (advantages/disadvantages, alternatives).

The students will understand the influence of weld quality on the performance and behavior of welded joints under static and cyclic load.

How the fatigue life of welded joints could be increased, will be part of the course.

requirements:

basics of material science (iron- and non-iron alloys), of electrical engineering, of production processes.

workload:

The workload for the lecture Welding Technology is 120 h per semester and consists of the presence during the lecture (18 h) as well as preparation and rework time at home (102 h).

Learning Content

definition, application and differentiation: welding,

welding processes, alternative connecting technologies.

history of welding technology

sources of energy for welding processes

Survey: Fusion welding,

pressure welding.

weld seam preparation/design

welding positions

weldability

gas welding, thermal cutting, manual metal-arc welding

submerged arc welding

gas-shielded metal-arc welding, friction stir welding, laser beam and electron beam welding, other fusion and pressure welding processes

static and cyclic behavior of welded joints,

fatigue life improvement techniques

Workload

The workload for the lecture Welding Technology is 120 h per semester and consists of the presence during the lecture (18 h) as well as preparation and rework time at home (102 h).

Literature

Für ergänzende, vertiefende Studien gibt das

Handbuch der Schweißtechnik von J. Ruge, Springer Verlag Berlin, mit seinen vier Bänden

Band I: Werkstoffe

Band II: Verfahren und Fertigung

Band III: Konstruktive Gestaltung der Bauteile

Band IV: Berechnung der Verbindungen

einen umfassenden Überblick. Der Stoff der Vorlesung Schweißtechnik findet sich in den Bänden I und II. Einen kompakten Einblick in die Lichtbogenschweißverfahren bietet das Bändchen

Nies: Lichtbogenschweißtechnik, Bibliothek der Technik Band 57, Verlag moderne Industrie AG und Co., Landsberg / Lech

Im Übrigen sei auf die zahlreichen Fachbücher des DVS Verlages, Düsseldorf, zu allen Einzelgebieten der Fügetechnik verwiesen.

T 11.431 Course: Windpower [T-MACH-105234]

Responsible: Dr. Norbert Lewald
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102627 - Major Field: Energy Converting Engines
M-MACH-102648 - Major Field: Energy Technology for Buildings

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Competence Certificate
written exam, 120 minutes

Prerequisites
none

T 11.432 Course: Workshop on computer-based flow measurement techniques [T-MACH-106707]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102591 - Laboratory Course
M-MACH-102610 - Major Field: Power Plant Technology
M-MACH-102623 - Major Field: Fundamentals of Energy Technology
M-MACH-102636 - Major Field: Thermal Turbomachines

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	1

Events					
SS 2019	2171488	Workshop on computer-based flow measurement techniques	3 SWS	Practical course (P)	Bauer, Mitarbeiter
WS 19/20	2171488	Workshop on computer-based flow measurement techniques	3 SWS	Practical course (P)	Bauer, Mitarbeiter
Exams					
SS 2019	76-T-MACH-106707	Workshop on computer-based flow measurement techniques		Prüfung (PR)	Bauer

Competence Certificate
Group colloquia for each topic

Duration: approximately 10 minutes

no tools or reference materials may be used

Prerequisites
none

Below you will find excerpts from events related to this course:

V Workshop on computer-based flow measurement techniques
2171488, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
The laboratory course offers an introduction into the acquisition of basic test data in fluid mechanics applications as well as a basic hands-on training for the application of modern PC based data acquisition methods. The combination of lectures about measurement techniques, sensors, signal converters, I/O systems, bus systems, data acquisition, handling and control routines and tutorials for typical fluid mechanics applications allows the participant to get a comprehensive insight and a sound knowledge in this field. The graphical programming environment LabVIEW from National Instruments is used in this course as it is one of the standard software tools for data acquisition worldwide.

Basic design of measurements systems

- Logging devices and sensors
- Analog to digital conversion
- Program design and programming methods using LabView
- Data handling
- Bus systems
- Design of a computer aided data acquisition system for pressure, temperature and derived parameters
- frequency analysis

Annotation
Registration during the lecture period via the website.

Workload
regular attendance: 52,5
self-study: 67,5

Literature
Germer, H.; Wefers, N.: Meßelektronik, Bd. 1, 1985

LabView User Manual

Hoffmann, Jörg: Taschenbuch der Messtechnik, 6., aktualisierte. Aufl. , 2011

V **Workshop on computer-based flow measurement techniques** **Practical course (P)**
2171488, WS 19/20, 3 SWS, Language: German, Open in study portal

Learning Content
The laboratory course offers an introduction into the acquisition of basic test data in fluid mechanics applications as well as a basic hands-on training for the application of modern PC based data acquisition methods. The combination of lectures about measurement techniques, sensors, signal converters, I/O systems, bus systems, data acquisition, handling and control routines and tutorials for typical fluid mechanics applications allows the participant to get a comprehensive insight and a sound knowledge in this field. The graphical programming environment LabVIEW from National Instruments is used in this course as it is one of the standard software tools for data acquisition worldwide.

Basic design of measurements systems

- Logging devices and sensors
- Analog to digital conversion
- Program design and programming methods using LabView
- Data handling
- Bus systems
- Design of a computer aided data acquisition system for pressure, temperature and derived parameters
- frequency analysis

Annotation
Registration during the lecture period via the website.

Workload
regular attendance: 52,5
self-study: 67,5

Literature
Germer, H.; Wefers, N.: Meßelektronik, Bd. 1, 1985

LabView User Manual

Hoffmann, Jörg: Taschenbuch der Messtechnik, 6., aktualisierte. Aufl. , 2011

T 11.433 Course: X-ray Optics [T-MACH-109122]

Responsible: Dr. Arndt Last
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102597 - Compulsory Elective Module Mechanical Engineering
M-MACH-102616 - Major Field: Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2141007	Röntgenoptik	2 SWS	Lecture (V)	Last
WS 19/20	2141007	X-ray Optics	2 SWS	Lecture (V)	Last
Exams					
SS 2019	76-T-MACH-109122	X-ray Optics		Prüfung (PR)	Last

Competence Certificate
oral exam (about 20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V X-ray Optics

Lecture (V)

2141007, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
The lecture covers general principles of optics as well as basics, functioning and application of reflective, refractive and diffractive X-ray optical elements and systems. Selected X-ray analytical imaging methods and the necessary optical elements are discussed including their potentials and limitations.

Annotation
Lecture dates will be fixed in agreement with the students, see institutes website.

A visit at synchrotron ANKA is possible if requested.

Workload
lecture times plus assignment to review

Literature
M. Born und E. Wolf
Principles of Optics, 7th (expanded) edition
Cambridge University Press, 2010

A. Erko, M. Idir, T. Krist und A. G. Michette
Modern Developments in X-Ray and Neutron Optics
Springer Series in Optical Sciences, Vol. 137
Springer-Verlag Berlin Heidelberg, 2008

D. Attwood
Soft X-Rays and Extreme Ultraviolet Radiation: Principles and Applications
Cambridge University Press, 1999

T 11.434 Course: ZAK lectures [T-MACH-106376]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102824 - Key Competences

Type	Credits	Recurrence	Version
Completed coursework	2	Each term	1

Competence Certificate
s. course

Prerequisites
none

Annotation
For details of conception and contents of the courses refer to www.zak.kit.edu/sq