Karlsruher Institut für Technologie

# Module Handbook
# Bachelor's Program Mechanical Engineering (B.Sc.)

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KIT DEPARTMENT OF MECHANICAL ENGINEERING

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# 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).

# Qualification Goals
## Mechanical Engineering (B.Sc.)

Through a research and practical orientation of the six-semester Bachelor's degree program for mechanical engineering at KIT, graduates of the program are prepared for lifelong learning and employment in typical professional fields of mechanical engineering in industry, services, and public administration. They acquire the academic qualifications to pursue a Master's degree program in mechanical engineering or related disciplines.

In the fundamental area of the studies, graduates acquire sound basic knowledge in engineering. With this in-depth knowledge of scientific theories, principles, and methods, graduates can successfully deal with clearly specified problems that have a unique solution approach in mechanical engineering.

In the specialization area of the studies and in the thesis, cross-disciplinary problem-solving and synthesis skills for engineering systems are developed. Graduates are able to generate new solutions in the areas of their choice of engineering.

Graduates of the Bachelor's degree program in mechanical engineering at KIT can select basic methods in order to create models and compare them in familiar situations. They are able to take over and to work independently on preset problems and resulting tasks in organized teams, to integrate the results of others and to present and interpret their own results in written form. They can identify, analyze, and develop systems and processes, and apply predefined assessment criteria, taking into account technical, economic, and social constraints.

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

# Amtliche Bekanntmachung

**2015** **Ausgegeben Karlsruhe, den 06. August 2015** **Nr. 62**

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**Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang Maschinenbau** **381**

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# Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang 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 Bachelorstudiengang Maschinenbau beschlossen.

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

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## 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 Bachelorprüfungsordnung regelt Studienablauf, Prüfungen und den Abschluss des Studiums im Bachelorstudiengang Maschinenbau am KIT.

### § 2 Ziel des Studiums, Akademischer Grad

**(1)** Im Bachelorstudium sollen die wissenschaftlichen Grundlagen und die Methodenkompetenz der Fachwissenschaften vermittelt werden. Ziel des Studiums ist die Fähigkeit, einen konsekutiven Masterstudiengang erfolgreich absolvieren zu können sowie das erworbene Wissen berufsfeldbezogen anwenden zu können.

**(2)** Aufgrund der bestandenen Bachelorprüfung wird der akademische Grad „Bachelor of Science (B.Sc.)“ für den Bachelorstudiengang Maschinenbau verliehen.

### § 3 Regelstudienzeit, Studienaufbau, Leistungspunkte

**(1)** Der Studiengang nimmt teil am Programm „Studienmodelle individueller Geschwindigkeit“. Die Studierenden haben im Rahmen der dortigen Kapazitäten und Regelungen bis einschließlich drittem Fachsemester Zugang zu den Veranstaltungen des MINT-Kollegs Baden-Württemberg (im folgenden MINT-Kolleg).

**(2)** Die Regelstudienzeit beträgt sechs Semester. Bei einer qualifizierten Teilnahme am MINT-Kolleg bleiben bei der Anrechnung auf die Regelstudienzeit bis zu zwei Semester unberücksichtigt. Die konkrete Anzahl der Semester richtet sich nach § 8 Absatz 2 Satz 3 bis 5.

Eine qualifizierte Teilnahme liegt vor, wenn die Studierende Veranstaltungen des MINT- Kollegs für die Dauer von mindestens einem Semester im Umfang von mindestens zwei Fachkursen (Gesamtworkload 10 Semesterwochenstunden) belegt hat. Das MINT-Kolleg stellt hierüber eine Bescheinigung aus.

**(3)** 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 § 20 festgelegt. Näheres beschreibt das Modulhandbuch.

**(4)** 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.

**(5)** Der Umfang der für den erfolgreichen Abschluss des Studiums erforderlichen Studien- und Prüfungsleistungen wird in Leistungspunkten gemessen und beträgt insgesamt 180 Leistungspunkte.

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

**§ 4 Modulprüfungen, Studien- und Prüfungsleistungen**

**(1)** Die Bachelorprüfung 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 Bachelorprüfung 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 Bachelorarbeit 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 Bachelorstudiengang 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 Bachelorstudiengang 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.

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**(5)** Die Zulassung ist abzulehnen, wenn die in Absatz 3 und 4 genannten Voraussetzungen nicht erfüllt sind.

**§ 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. 5 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 einer solchen 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/zur 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 der 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 und fachliche Betreuung zu gewährleisten. 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.

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**(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 Bachelorprüfung, die Fachnoten und die Modulnoten lauten:

| | | | | | |
|---|---|---|---|---|---|
| | | bis | 1,5 | = | sehr gut |
| von | 1,6 | bis | 2,5 | = | gut |
| von | 2,6 | bis | 3,5 | = | befriedigend |
| von | 3,6 | bis | 4,0 | = | ausreichend |

**§ 8 Orientierungsprüfungen, Verlust des Prüfungsanspruchs**

**(1)** Die Teilmodulprüfungen Höhere Mathematik I, Technische Mechanik I, Technische Mechanik II in den Modulen Höhere Mathematik und Technische Mechanik sind bis zum Ende des Prüfungszeitraums des zweiten Fachsemesters abzulegen (Orientierungsprüfungen).

**(2)** Wer die Orientierungsprüfungen einschließlich etwaiger Wiederholungen bis zum Ende des Prüfungszeitraums des dritten Fachsemesters nicht erfolgreich abgelegt hat, verliert den Prüfungsanspruch im Studiengang, es sei denn, dass die Fristüberschreitung nicht selbst zu vertreten ist; hierüber entscheidet der Prüfungsausschuss auf Antrag der oder des Studierenden. Eine zweite Wiederholung der Orientierungsprüfungen ist ausgeschlossen.

Die Fristüberschreitung hat die/der Studierende insbesondere dann nicht zu vertreten, wenn eine qualifizierte Teilnahme am MINT-Kolleg im Sinne von § 3 Abs. 2 vorliegt. Ohne ausdrückliche Genehmigung des Vorsitzenden des Prüfungsausschusses gilt eine Fristüberschreitung von

1. einem Semester als genehmigt, wenn die/der Studierende eine qualifizierte Teilnahme am MINT-Kolleg gemäß § 3 Abs. 2 im Umfang von einem Semester nachweist oder
2. zwei Semestern als genehmigt, wenn die/der Studierende eine qualifizierte Teilnahme am MINT-Kolleg gemäß § 3 Abs. 2 im Umfang von zwei Semestern nachweist.

Als Nachweis gilt die vom MINT-Kolleg gemäß § 3 Abs. 2 auszustellende Bescheinigung, die beim Studierendenservice des KIT einzureichen ist. Im Falle von Nr. 1 kann der Vorsitzende des Prüfungsausschusses auf Antrag der Studierenden die Frist um ein weiteres Semester verlängern, wenn dies aus studienorganisatorischen Gründen für das fristgerechte Ablegen der Orientierungsprüfung erforderlich ist, insbesondere weil die Module, die Bestandteil der Orientierungsprüfung sind, nur einmal jährlich angeboten werden.

**(3)** Ist die Bachelorprüfung bis zum Ende des Prüfungszeitraums des neunten Fachsemesters einschließlich etwaiger Wiederholungen nicht vollständig abgelegt, so erlischt der Prüfungsan-

spruch 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 in Satz 1 genannten Studienhöchstdauer zu stellen. *Absatz 2 Satz 3 bis 5 gelten entsprechend.*

**(4)** Der Prüfungsanspruch geht auch verloren, wenn eine nach dieser Studien- und Prüfungsordnung erforderliche Studien- oder Prüfungsleistung endgültig nicht bestanden ist oder eine Wiederholungsprüfung nach § 9 Abs. 6 nicht rechtzeitig erbracht wurde, es sei denn die Fristüberschreitung ist nicht selbst zu vertreten.

**§ 9 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 Bachelorarbeit kann bei einer Bewertung mit „nicht ausreichend“ (5,0) einmal wiederholt werden. Eine zweite Wiederholung der Bachelorarbeit ist ausgeschlossen.

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**§ 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 Bachelorarbeit 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 Bachelorarbeit 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 Studierender 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 § 20 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 Bachelorarbeit

**(1)** Voraussetzung für die Zulassung zum Modul Bachelorarbeit ist, dass die/der Studierende Modulprüfungen im Umfang von 120 LP erfolgreich abgelegt hat. Über Ausnahmen entscheidet der Prüfungsausschuss auf Antrag der/des Studierenden.

**(1 a)** Dem Modul Bachelorarbeit sind 15 LP zugeordnet. Es besteht aus der Bachelorarbeit und einer Präsentation. Die Präsentation hat spätestens sechs Wochen nach Abgabe der Bachelorarbeit zu erfolgen.

**(2)** Die Bachelorarbeit 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 § 18 Abs. 2 und 3 zur Vergabe des Themas berechtigen. Den Studierenden ist Gelegenheit zu geben, für das Thema Vorschläge zu machen. Soll die Bachelorarbeit außerhalb der KIT-Fakultät für Maschinenbau angefertigt werden, so bedarf dies der Genehmigung durch den Prüfungsausschuss. Die Bachelorarbeit 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 Bachelorarbeit erhält. Die Ausgabe des Themas erfolgt in diesem Fall über die/den Vorsitzende/n des Prüfungsausschusses.

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

**(4)** Die Bachelorarbeit 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 Bachelorarbeit entspricht 12 Leistungspunkten. Die maximale Bearbeitungsdauer beträgt drei Monate. Thema und Aufgabenstellung sind an den vorgesehenen Umfang anzupassen. Der Prüfungsausschuss legt fest, in welchen Sprachen die Bachelorarbeit geschrieben werden kann. Auf Antrag des Studierenden kann der/die Prüfende genehmigen, dass die Bachelorarbeit in einer anderen Sprache als Deutsch geschrieben wird.

**(5)** Bei der Abgabe der Bachelorarbeit 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 Bachelorarbeit mit „nicht ausreichend“ (5,0) bewertet.

**(6)** Der Zeitpunkt der Ausgabe des Themas der Bachelorarbeit ist durch die Betreuerin/den Betreuer und die/den Studierenden festzuhalten und dies beim Prüfungsausschuss aktenkundig zu machen. Der Zeitpunkt der Abgabe der Bachelorarbeit 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 3 festgelegte Bearbeitungszeit auf Antrag der oder des Studierenden um höchstens einen Monat verlängern. Wird die Bachelorarbeit 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 Bachelorarbeit 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 Bachelorarbeit fest; er kann auch einen weiteren Gutachter bestellen. Die Bewertung hat innerhalb von sechs Wochen nach Abgabe der Bachelorarbeit 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 Bachelorzeugnis 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.

**§ 15 a Mastervorzug**

Studierende, die im Bachelorstudium bereits mindestens 120 LP erworben haben, können zusätzlich zu den in § 15 Abs. 1 genannten Zusatzleistungen Leistungspunkte aus einem konsekutiven Masterstudiengang am KIT im Umfang von höchstens 30 LP erwerben (Mastervorzugsleistungen). § 3 und § 4 der Prüfungsordnung bleiben davon unberührt. Die Mastervorzugsleistungen gehen nicht in die Festsetzung der Gesamt-, Fach- und Modulnoten ein. Sie werden im Transcript of Records aufgeführt und als solche gekennzeichnet sowie mit den nach § 7 vorgesehenen Noten gelistet. § 15 Absatz 2 gilt entsprechend.

**§ 16 Überfachliche Qualifikationen**

Neben der Vermittlung von fachlichen Qualifikationen ist der Auf- und Ausbau überfachlicher Qualifikationen im Umfang von mindestens 6 LP Bestandteil eines Bachelorstudiums. Überfachliche Qualifikationen können additiv oder integrativ vermittelt werden.

**§ 17 Prüfungsausschüsse**

**(1)** Für den Bachelorstudiengang werden Prüfungsausschüsse gebildet. Sie bestehen jeweils 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 jeweiligen 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 jeweiligen Prüfungsausschusses nimmt die laufenden Geschäfte wahr und wird durch das jeweilige Prüfungssekretariat unterstützt.

**(3)** Der jeweilige 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 § 19 Absatz 1 Satz 1. Er berichtet der KIT-Fakultät regelmäßig über die Entwicklung der Prüfungs- und Studienzeiten, einschließlich der Bearbeitungszeiten für die Bachelorarbeiten 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.

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**(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.

### § 18 Prüfende und Beisitzende

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

**(2)** Prüfende sind Hochschullehr/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.

### § 19 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 Studiengang 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 Hochschul-

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

## II. Bachelorprüfung

### § 20 Umfang und Art der Bachelorprüfung

**(1)** Die Bachelorprüfung besteht aus den Modulprüfungen nach Absatz 2 sowie dem Modul Bachelorarbeit (§ 14).

**(2)** Es sind Modulprüfungen in folgenden Pflichtfächern abzulegen:

1. Ingenieurwissenschaftliche Grundlagen: Modul(e) im Umfang von 143 LP,

2. Vertiefung im Maschinenbau: Modul(e) im Umfang von 16 LP,

3. Überfachliche Qualifikationen im Umfang von 6 LP gemäß § 16.

Die Festlegung der zur Auswahl stehenden Module und deren Fachzuordnung werden im Modulhandbuch getroffen.

### § 21 Bestehen der Bachelorprüfung, Bildung der Gesamtnote

**(1)** Die Bachelorprüfung ist bestanden, wenn alle in § 20 genannten Modulprüfungen mindestens mit „ausreichend“ bewertet wurden.

**(2)** Die Gesamtnote der Bachelorprüfung errechnet sich als ein mit Leistungspunkten gewichteter Notendurchschnitt der Fachnoten sowie des Moduls Bachelorarbeit.

Dabei wird die Note des Moduls Bachelorarbeit mit dem doppelten Gewicht gegenüber den Noten der übrigen Fächer berücksichtigt.

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

### § 22 Bachelorzeugnis, Bachelorurkunde, Diploma Supplement und Transcript of Records

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

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**(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 jeweiligen 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 Bachelorurkunde, das Bachelorzeugnis und das Diploma Supplement einschließlich des Transcript of Records werden vom Studierendenservice des KIT ausgestellt.

## III. Schlussbestimmungen

### § 23 Bescheinigung von Prüfungsleistungen

Haben Studierende die Bachelorprüfung 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.

### § 24 Aberkennung des Bachelorgrades

**(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 Bachelorprüfung für „nicht bestanden“ erklärt werden.

**(2)** Waren die Voraussetzungen für die Zulassung zu einer Prüfung nicht erfüllt, ohne dass 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 Bachelorprüfung 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 Bachelorurkunde einzuziehen, wenn die Bachelorprüfung 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.

**§ 25 Einsicht in die Prüfungsakten**

**(1)** Nach Abschluss der Bachelorprüfung wird den Studierenden auf Antrag innerhalb eines Jahres Einsicht in das Prüfungsexemplar ihrer Bachelorarbeit, 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.

**§ 26 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 Bachelorstudiengang Maschinenbau vom 28. Februar 2008 (Amtliche Bekanntmachung des KIT Nr. 78 vom 09. September 2008), zuletzt geändert durch Satzung vom 24. September 2014 (Amtliche Bekanntmachung des KIT Nr. 53 vom 01. Oktober 2014), außer Kraft.

**(3)** Studierende, die auf Grundlage der Studien- und Prüfungsordnung für den Bachelorstudiengang Maschinenbau vom 28. Februar 2008 (Amtliche Bekanntmachung des KIT Nr. 78 vom 09. September 2008), zuletzt geändert durch Satzung vom 24. September 2014 (Amtliche Bekanntmachung des KIT Nr. 53 vom 01. Oktober 2014), ihr Studium am KIT aufgenommen haben, können Prüfungen auf Grundlage dieser Studien- und Prüfungsordnung letztmalig am 30. September 2021 ablegen.

**(4)** Studierende, die auf Grundlage der Studien- und Prüfungsordnung für den Bachelorstudiengang Maschinenbau vom 28. Februar 2008 (Amtliche Bekanntmachung des KIT Nr. 78 vom 09. September 2008), zuletzt geändert durch Satzung vom 24. September 2014 (Amtliche Bekanntmachung des KIT Nr. 53 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. 03**

**I n h a l t** **Seite**

**Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang Maschinenbau** **26**

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## Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang 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 Bachelorstudiengang Maschinenbau vom 04. August 2015 (Amtliche Bekanntmachung des Karlsruher Instituts für Technologie (KIT) Nr. 62 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. § 9 Absatz 11 werden folgende Sätze 3 und 4 angefügt:**

„Die Präsentation nach § 14 Absatz 1 a ist eine Studienleistung und kann bei einer Bewertung mit „nicht bestanden (not passed)“ (im Gegensatz zu anderen Studienleistungen) nur einmal wiederholt werden. Die Präsentation ist endgültig nicht bestanden, wenn sie zweimal mit „nicht bestanden“ (not passed) bewertet wurde.“

**2. § 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

**3. § 14 wird wie folgt geändert:**

a) In Absatz 1 a Satz 2 wird nach dem Wort „Bachelorarbeit“ die Angabe „mit 12 LP“ und nach dem Wort „Präsentation“ die Angabe „mit 3 LP“ eingefügt.

b) 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.

c) 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.

**4. § 17 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.

**5. § 18 Absatz 3 wird wie folgt geändert:**

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

**6. § 26 Absatz 5 wird aufgehoben und folgender neuer Absatz 5 eingefügt:**

„(5) Für Studierende, die

1. ihr Studium im Bachelorstudiengang Maschinenbau vor dem Wintersemester 2018/2019 aufgenommen haben oder

2. ihr Studium im Bachelorstudiengang Maschinenbau ab dem Wintersemester 2018/2019 in einem höheren Fachsemester aufgenommen haben bzw. aufnehmen sofern das Fachsemester über dem Jahrgang der Studienanfänger zum Wintersemester 2018/2019 liegt,

finden § 9 Abs. 11 und § 14 Abs. 1 a in der Fassung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang Maschinenbau vom 04. August 2015 (Amtliche Bekanntmachung des KIT Nr. 62 vom 06. August 2015) weiterhin Anwendung.

Studierende nach Satz 1 Ziffer 1 und Ziffer 2, können das Modul Bachelorarbeit auf Grundlage der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Bachelorstudiengang Maschinenbau in der Fassung vom 04. August 2015 (Amtliche Bekanntmachung des KIT Nr. 62 vom 06. August 2015) letztmalig bis zum 31. März 2023 ablegen“

**Artikel 2 – Inkrafttreten**

Diese Änderungssatzung tritt zum 01. April 2019 in Kraft.

Karlsruhe, den 21. Februar 2019

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

# 5 Field of study structure

| Mandatory | |
|---|---|
| Orientation Exam<br>*This field will not influence the calculated grade of its parent.* | |
| Bachelor's Thesis | 15 CR |
| Fundamentals of Engineering | 143 CR |
| Specialization in Mechanical Engineering | 16 CR |
| Interdisciplinary Qualifications | 6 CR |
| **Voluntary** | |
| Additional Examinations<br>*This field will not influence the calculated grade of its parent.* | |

## 5.1 Orientation Exam

| Mandatory | | |
|---|---|---|
| M-MACH-104624 | Orientation Exam | 0 CR |

## 5.2 Bachelor's Thesis

**Credits**
15

| Mandatory | | |
|---|---|---|
| M-MACH-104494 | Bachelor's Thesis | 15 CR |

## 5.3 Fundamentals of Engineering

**Credits**
143

| Mandatory | | |
|---|---|---|
| M-MATH-102859 | Advanced Mathematics | 21 CR |
| M-MACH-102572 | Engineering Mechanics | 23 CR |
| M-MACH-102562 | Materials Science | 14 CR |
| M-MACH-102574 | Technical Thermodynamics | 15 CR |
| M-MACH-102565 | Fluid Mechanics | 8 CR |
| M-PHYS-104030 | Physics | 5 CR |
| M-ETIT-104801 | Electrical Engineering<br>*First usage possible from Mar 08, 2019.* | 8 CR |
| M-MACH-102564 | Measurement and Control Systems | 7 CR |
| M-MACH-102563 | Computer Science | 6 CR |
| M-MACH-102573 | Mechanical Design | 20 CR |
| M-MACH-102566 | Machines and Processes | 7 CR |
| M-MACH-102549 | Manufacturing Processes | 4 CR |
| M-MACH-105902 | Sustainable Production Economics<br>*First usage possible from Oct 01, 2022.* | 5 CR |

## 5.4 Specialization in Mechanical Engineering

**Credits**
16

| | | |
|---|---|---|
| **Mandatory** | | |
| M-MACH-102746 | Compulsory Elective Module | 4 CR |
| **Major Field (Election: 1 item)** | | |
| M-MACH-102812 | Major Field: Powertrain Systems | 12 CR |
| M-MACH-102638 | Major Field: Rail System Technology | 12 CR |
| M-MACH-102815 | Major Field: Engineering Design | 12 CR |
| M-MACH-102582 | Major Field: Continuum Mechanics | 12 CR |
| M-MACH-102816 | Major Field: Fundamentals of Energy Technology | 12 CR |
| M-MACH-102583 | Major Field: Information Management | 12 CR |
| M-MACH-102817 | Major Field: Information Technology | 12 CR |
| M-MACH-102818 | Major Field: Vehicle Technology | 12 CR |
| M-MACH-102838 | Major Field: Energy Converting Engines | 12 CR |
| M-MACH-102819 | Major Field: Materials Science and Engineering | 12 CR |
| M-MACH-102820 | Major Field: Mechatronics | 12 CR |
| M-MACH-104430 | Major Field: Modeling and Simulation in Dynamics | 12 CR |
| M-MACH-102589 | Major Field: Production Systems | 12 CR |
| M-MACH-104442 | Major Field: Vibration Theory | 12 CR |
| M-MACH-102645 | Major Field: Combustion Engine Techniques | 12 CR |
| M-MACH-102821 | Major Field: Technical Logistics | 12 CR |

## 5.5 Interdisciplinary Qualifications

**Credits**
6

| | | |
|---|---|---|
| **Mandatory** | | |
| M-MACH-102576 | Key Competencies | 6 CR |

## 5.6 Additional Examinations

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

# Studienplan der KIT-Fakultät für Maschinenbau für den Bachelorstudiengang Maschinenbau gemäß SPO 2015

**Fassung vom 01.12.2021**
**letzte redaktionelle Änderung am 23.08.2024**

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## 0 Abkürzungsverzeichnis

| | | |
|---|---|---|
| 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 |
| | E(P), E/P | Teilleistung Praktikum im Ergänzungsbereich des Schwerpunkts, unbenotet |
| 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 |
| | Üschein | Übungsschein, Studienleistung |
| | Pschein | Praktikumsschein, Studienleistung |
| | Schein | unbenotete Modulleistung, Studienleistung |
| | 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

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 von der Prüfungskommission 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 sechs 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 können solange beliebig oft wiederholt werden, bis diese erfolgreich bestanden wurden.

## 1.2 Module des Bachelorstudiums

Voraussetzung für die Zulassung zu den Modulprüfungen ist der Nachweis über die unten aufgeführten Studienleistungen. Schriftliche Prüfungen werden als Klausuren mit der angegebenen Prüfungsdauer in Stunden abgenommen. Prüfungsleistungen gehen mit dem angegebenen Gewicht (Gew) in die Modulnote bzw. die Gesamtnote ein. Zur Berechnung der Modul- und Fachnoten wird auf §7 Abs. 4 und 9 in der SPO verwiesen. Die Teilmodulprüfungen Höhere Mathematik 1, Technische Mechanik 1 und Technische Mechanik 2 sind Orientierungsprüfungen. Zu den Regelungen wird auf §8 der SPO verwiesen.

Das in § 16 SPO beschriebene Fach „Überfachliche Qualifikationen“ bildet das Modul „Schlüsselqualifikationen“ mit einem Umfang von 6 Leistungspunkten.

| Fach | Modul | LP/ Modul | Teilleistung | LP | Koordinator | Art der Erfolgskontrolle | | Gew |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Studienleistungen | Prüfungsleistungen | |
| Ingenieurwissenschaftliche Grundlagen | Höhere Mathematik | 21 | Höhere Mathematik I | 7 | Kirsch | Üschein | sPr | 7 |
| | | | Höhere Mathematik II | 7 | | ÜSchein | sPr | 7 |
| | | | Höhere Mathematik III | 7 | | ÜSchein | sPr | 7 |
| | Technische Mechanik | 23 | Technische Mechanik I | 7 | Böhlke | Üschein | sPr | 7 |
| | | | Technische Mechanik II | 6 | | Üschein | sPr | 6 |
| | | | Technische Mechanik III & IV | 10 | N.N. | Üschein<br>Üschein | sPr | 10 |
| | Werkstoffkunde | 14 | Werkstoffkunde I & II | 11 | Heilmaier | | mPr | 14 |
| | | | Werkstoffkunde-Praktikum | 3 | | Pschein | | |
| | Technische Thermodynamik | 15 | Technische Thermo-dynamik und Wärmeübertragung I | 8 | Maas | Üschein | sPr | 8 |
| | | | Technische Thermodynamik und Wärmeübertragung II | 7 | | Üschein | sPr | 7 |
| | Strömungslehre | 8 | Strömungslehre I & II | 8 | Frohnapfel | | sPr | 8 |
| | Physik | 5 | Wellen- und Quantenphysik | 5 | Pilawa | | sPr | 5 |
| | Elektrotechnik | 8 | Elektrotechnik und Elektronik | 8 | Becker | | sPr | 8 |
| | Mess- und Regelungstechnik | 7 | Grundlagen der Mess- und Regelungstechnik | 7 | Stiller | | sPr | 7 |

| Fach | Modul | LP/ Modul | Teilleistung | LP | Koordinator | Art der Erfolgskontrolle | | Gew |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Studienleistungen | Prüfungsleistungen | |
| | Informatik | 6 | Informatik im Maschinenbau | 6 | Ovtcharova | Pschein | sPr | 6 |
| | Maschinenkonstruktionslehre | 20 | Maschinenkonstruktionslehre I & II | 7 | Albers | Üschein<br>Üschein | sPr | 7 |
| | | | Maschinenkonstruktionslehre III & IV | 13 | | Üschein<br>Üschein | sPr | 13 |
| | Maschinen und Prozesse | 7 | Maschinen und Prozesse | 7 | Kubach | Pschein | sPr | 7 |
| | Fertigungsprozesse | 4 | Grundlagen der Fertigungstechnik | 4 | Schulze | | sPr | 4 |
| | Nachhaltige Produktionswirtschaft | 5 | Nachhaltige Produktionswirtschaft | 5 | Lanza | | sPr | 5 |
| Vertiefung im Maschinenbau | Schwerpunkt | 12 | Kern- und Ergänzungsbereich, wählbare TL siehe Modulhandbuch | 12 | SP-Verantwortlicher | <br> | mPr<br>mPr | 12 |
| | Wahlpflichtmodul | 4 | wählbare TL siehe Modulhandbuch | 4 | Heilmaier | | mPr | 4 |
| Überfachliche Qualifikationen | Schlüsselqualifikationen | 6 | Wissenschaftliches Arbeiten und empirische Forschungsmethoden | 4 | Deml | Schein | | |
| | | | wählbare TL von HoC, FORUM (ehemals ZAK) bzw. weitere, siehe Modulhandbuch | 2 | N.N. | Schein | | |
| Bachelorarbeit | Bachelorarbeit | 15 | Bachelorarbeit | 12 | | | PraA | 30 |
| | | | Präsentation | 3 | | | | |

### 1.3 Studienplan

| **Lehrveranstaltungen 1. bis 4. Semester** Angaben in Semesterwochenstunden (SWS) | WS 1. Sem. | | | SS 2. Sem. | | | WS 3. Sem. | | | SS 4. Sem. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | V | Ü | P | V | Ü | P | V | Ü | P | V | Ü | P |
| Höhere Mathematik I-III | 4 | 2 | | 4 | 2 | | 4 | 2 | | | | |
| Grundlagen der Fertigungstechnik | 2 | | | | | | | | | | | |
| Wellen- und Quantenphysik | | | | | | | | | | 2 | 1 | |
| Technische Mechanik I-IV | 3 | 2 | | 3 | 2 | | 2 | 2 | | 2 | 2 | |
| Werkstoffkunde I, II | 4 | 1 | | 2 | 1 | | | | | | | |
| Werkstoffkunde-Praktikum[1] | | | | | | 2 | | | | | | |
| Technische Thermodynamik und Wärmeübertragung I, II | | | | | | | 4 | 2 | | 3 | 2 | |
| Maschinenkonstruktionslehre I-IV | 2 | 1 | | 2 | 2 | | 2 | 2 | 1 | 2 | 2 | 1 |
| Informatik im Maschinenbau | | | | 2 | 2 | 2 | | | | | | |
| Elektrotechnik und Elektronik | | | | | | | 4 | 2 | | | | |
| Strömungslehre I | | | | | | | | | | 2 | 1 | |
| Wiss. Arbeiten und empirische Forschungsmethoden | | | | | | | | | | 1 | | 1 |

| **Lehrveranstaltungen 5. bis 6. Semester** Angaben in Semesterwochenstunden (SWS) | WS 5. Sem. | | | SS 6. Sem. | | |
|---|---|---|---|---|---|---|
| | V | Ü | P | V | Ü | P |
| Grundlagen der Mess- und Regelungstechnik | 3 | 1 | | | | |
| Strömungslehre II | 2 | 1 | | | | |
| Maschinen und Prozesse | 4 | | 1 | | | |
| Nachhaltige Produktionswirtschaft | 3 | 1 | | | | |
| Schlüsselqualifikationen | | | | 2 | | |
| Wahlpflichtmodul | (2) | | | 2 | | |
| Schwerpunkt (6 SWS, variabel) | 3 | ( ) | ( ) | 3 | ( ) | ( ) |

### 1.4 Bachelorarbeit

Das Modul Bachelorarbeit besteht aus einer schriftlichen Ausarbeitung (Bachelorarbeit, 12 LP) sowie einer mündlichen Präsentation (3 LP). Die Präsentation soll spätestens sechs Wochen nach Abgabe der Bachelorarbeit erfolgen. Die Präsentation soll ca. 20 Minuten dauern und wird anschließend mit dem anwesenden Fachpublikum diskutiert.
Die Durchführung und Benotung der Bachelorarbeit ist in § 14 der SPO für den Bachelorstudiengang Maschinenbau sowie im Modulhandbuch unter „Modul Bachelorarbeit“ geregelt.

[1] Das Werkstoffkunde-Praktikum findet in der vorlesungsfreien Zeit zwischen SS und WS statt und beansprucht eine Woche.

## 2 Schwerpunkte

Folgende Schwerpunkte sind derzeit vom Fakultätsrat genehmigt (siehe Angaben im Modulhandbuch):

| Schwerpunkt | Verantwortlicher | SP-Nr. |
|---|---|---|
| Antriebssysteme | Albers | 2 |
| Bahnsystemtechnik | Gratzfeld | 50 |
| Entwicklung und Konstruktion | Albers | 10 |
| Kontinuumsmechanik | Böhlke | 13 |
| Grundlagen der Energietechnik | Bauer | 15 |
| Informationsmanagement | Ovtcharova | 17 |
| Informationstechnik | Stiller | 18 |
| Kraftfahrzeugtechnik | Gauterin | 12 |
| Kraft- und Arbeitsmaschinen | Th. Koch | 24 |
| Materialwissenschaft und Werkstofftechnik | Heilmaier | 26 |
| Mechatronik | Hagenmeyer | 31 |
| Modellbildung und Simulation in der Dynamik | Fidlin | 61 |
| Produktionssysteme | Schulze | 38 |
| Schwingungslehre | Fidlin | 60 |
| Technische Logistik | Furmans | 44 |
| Technik des Verbrennungsmotors | Th. Koch | 57 |

Für den Schwerpunkt werden Teilleistungen im Umfang von 12 LP gewählt, davon werden mindestens 8 LP im Kernbereich (K) erworben. „KP“ bedeutet, dass die Teilleistung im Kernbereich Pflicht ist, sofern sie nicht bereits belegt wurde. Die übrigen 4 LP können aus dem Ergänzungsbereich kommen. Dabei dürfen im Rahmen von Praktika höchstens 4 LP erworben werden, die auch als unbenotete Modulleistung 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 Schwerpunktverantwortlichen gewählt werden. Dabei ist eine Kombination mit Teilleistungen aus den Bereichen Informatik, Elektrotechnik und Mathematik in einigen Schwerpunkten besonders willkommen. Mit „EM“ gekennzeichnete Teilleistungen stehen im Bachelorstudiengang nicht zur Wahl. Für manche Schwerpunkte wird die Belegung einer bestimmten Teilleistung im Rahmen des Wahlpflichtmoduls empfohlen (s. Empfehlungen im Modulhandbuch).

Ein Absolvieren des Schwerpunktmoduls mit mehr als 12 LP ist nur im Fall, dass die Addition innerhalb des Schwerpunktmoduls nicht auf 12 LP aufgeht, erlaubt. Nicht zulässig ist es jedoch, noch weitere Teilleistungen anzumelden, wenn bereits 12 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 Prüfungsleistungen abgeschlossenen Teilleistungen. Dabei werden alle Teilleistungen gemäß ihrer LP gewichtet. Bei der Bildung der Gesamtnote wird der Schwerpunkt mit 12 LP gewertet.

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

## 3 Änderungshistorie (ab 20.07.2016)

| | |
|---|---|
| 20.07.2016 | Sprachliche Anpassung an das Eckpunktepapier des KIT, Überarbeitung der Prüfungsmodalitäten |
| 17.08.2016 | Redaktionelle Änderungen, u.a. im Modul Physik |
| 28.06.2017 | Redaktionelle Änderungen, u.a. in den Modulen Technische Thermodynamik und Strömungslehre |
| 13.07.2018 | Anpassung der Schwerpunkte sowie redaktionelle Änderungen |
| 30.08.2019 | Redaktionelle Änderungen, u.a. in Punkt 1 |
| 15.02.2020 | Redaktionelle Änderungen, u.a. in Punkt 1.2 |
| 30.03.2020 | Namensänderung von SP 13 |
| 01.07.2020 | SP 52 gelöscht |
| 01.12.2021 | BPW durch Nachhaltige Produktionswirtschaft ersetzt |

# 7 Modules

## M 7.1 Module: Advanced Mathematics [M-MATH-102859]

**Responsible:** Prof. Dr. Roland Griesmaier
**Organisation:** KIT Department of Mathematics
**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Duration | Language | Level | Version |
|---|---|---|---|---|---|
| 21 | Grade to a tenth | 3 terms | German | 3 | 1 |

| Mandatory | | | |
|---|---|---|---|
| T-MATH-100525 | Tutorial Advanced Mathematics I | 0 CR | Arens, Griesmaier, Hettlich |
| T-MATH-100526 | Tutorial Advanced Mathematics II | 0 CR | Arens, Griesmaier, Hettlich |
| T-MATH-100527 | Tutorial Advanced Mathematics III | 0 CR | Arens, Griesmaier, Hettlich |
| T-MATH-100275 | Advanced Mathematics I | 7 CR | Arens, Griesmaier, Hettlich |
| T-MATH-100276 | Advanced Mathematics II | 7 CR | Arens, Griesmaier, Hettlich |
| T-MATH-100277 | Advanced Mathematics III | 7 CR | Arens, Griesmaier, Hettlich |

**Competence Certificate**
Learning assessment is carried by three written examinations of length 120 minutes each and by three sets of homework assignments (pre-requesites). A "pass" result on a pre-requesites in Advanced Mathematics I, II and III, respectively, is a requirement for registration for the corresponding written examination.

**Prerequisites**
None.

**Competence Goal**
The students know the fundamentals of one-dimensional calculus. They can reliably use limits, functions, power series and integrals. They understand central concepts such as continuity, differentiability or integrability and they know important statements about these concepts. The students can follow the arguments leading to these statements as presented in the lectures and are able to independently prove simple assertions based on these statements.

The students know about the fundamentals of linear algebra. The are able to use vectors, linear maps and matrices without problems. They have basic knowledge about Fourier series. The students also can theoretically and practically deal with initial value problems of ordinary differential equations. They can make use of classical solution techniques for linear differential equations.

The students know about differential calculus for vector-valued functions of several variables and about techniques of vector calculus such as the definition and application of differential operators, the computation of domain, line and surface integrals and important integral theorems. They have basic knowledge about partial differential equations and know basic facts from stochastics.

**Content**
Fundamentals, sequences and convergence, functions and continuity, series, differential calculus of one real variable, integral calculus, vector spaces, linear maps, eigenvalues, Fourier series, differential equations, Laplace transform, multidimensional calculus, domain integrals, vector calculus, partial differential equations, stochastics

**Workload**
**In class: 270 hours**

- lectures, tutorials and examinations

**Independent study: 360 hours**

- independent review of course material
- work on homework assignments
- preparation for written exams

**Learning type**
Lecture, problem classes, tutorials

# M 7.2 Module: Bachelor's Thesis [M-MACH-104494]

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

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 15 | Grade to a tenth | Each term | 1 term | German | 3 | 1 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-109188 | Bachelor's Thesis | 12 CR | Heilmaier |
| T-MACH-109189 | Presentation | 3 CR | Heilmaier |

**Competence Certificate**
The module Bachelor Thesis consists of a written bachelor thesis and an oral presentation of a scientific subject chosen by the student himself/herself or given by the supervisor. The bachelor 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 work load of the bachelor thesis corresponds to 12 ECTS. The maximal processing time of the bachelor thesis takes three months.
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 bachelor 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 bachelor thesis is not completed in time, this examination is "failed" (5,0), unless the student is not responsible.
The bachelor thesis is to be evaluated by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 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 bachelor thesis is graded by the examination board within this assessment; another expert can be appointed too. The bachelor 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 bachelor thesis. The presentation should last around 20 minutes, corresponds to 3 ECTS, and is followed by a scientific discussion with the present expert audience.

**Prerequisites**
The requirement for admission to the bachelor thesis module are 120 ECTS. As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

**Modeled Conditions**
The following conditions have to be fulfilled:

1. You need to have earned at least 120 credits in the following fields:
   - Fundamentals of Engineering
   - Interdisciplinary Qualifications
   - Specialization in Mechanical Engineering

**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, 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 a question, is able to choose scientific methods and techniques, and use them to solve the question or to identify other potentials. In general, 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. He/she is able to clearly structure a scientific work and (a) to communicate it in written form using technical terminology as well as (b) to present it in oral form and discuss it with experts.

**Content**
The student shall be allowed to make suggestions for the topic of his/her bachelor 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 bachelor thesis is about 450 hours.

# M 7.3 Module: Compulsory Elective Module (BSc-Modul WPF) [M-MACH-102746]

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

**Part of:** Specialization in Mechanical Engineering (mandatory)

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

| **Compulsory Elective Module (Election: 1 item)** | | | |
|---|---|---|---|
| T-MACH-105381 | Virtual Engineering (Specific Topics) | 4 CR | Ovtcharova |
| T-MACH-112717 | Dimensioning of Additive-Manufactured Polymer Structures at an Example from Medical Engineering | 4 CR | Kärger |
| T-MACH-105212 | CAE-Workshop | 4 CR | Albers, Matthiesen |
| T-MACH-105320 | Introduction to the Finite Element Method | 3 CR | Böhlke, Langhoff |
| T-MACH-100535 | Introduction into Mechatronics | 6 CR | Orth, Reischl |
| T-MACH-105209 | Introduction to Multi-Body Dynamics | 5 CR | Römer |
| T-MACH-110362 | Introduction to Computational Fluid Dynamics | 3 CR | Frohnapfel, Stroh |
| T-MACH-102093 | Fluid Power Systems | 4 CR | Geimer |
| T-MACH-109919 | Basics of Technical Logistics I | 4 CR | Mittwollen, Oellerich |
| T-MACH-105213 | Fundamentals of Combustion I | 4 CR | Maas |
| T-MACH-110377 | Continuum Mechanics of Solids and Fluids | 3 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-105294 | Mathematical Methods of Vibration Theory | 6 CR | Fidlin, Höllig, Römer |
| T-MACH-105295 | Mathematical Methods in Fluid Mechanics | 6 CR | Frohnapfel |
| 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-105147 | Product Lifecycle Management | 4 CR | Ovtcharova |
| T-MACH-105970 | Structural Analysis of Composite Laminates | 4 CR | Kärger |
| T-MACH-100531 | Systematic Materials Selection | 4 CR | Dietrich, Schulze |
| 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 |
| T-MACH-105292 | Heat and Mass Transfer | 4 CR | Maas, Yu |
| T-MACH-100532 | Scientific Computing for Engineers | 4 CR | Gumbsch, Weygand |
| **Compulsary Elective Module (Tutorial) (Election: )** | | | |
| T-MACH-110330 | Tutorial Introduction to the Finite Element Method | 1 CR | Böhlke, Langhoff |
| T-MACH-111033 | Tutorial Introduction to Computational Fluid Dynamics | 1 CR | Frohnapfel, Stroh |
| T-MACH-110333 | Tutorial Continuum Mechanics of Solids and Fluids | 1 CR | Böhlke, Frohnapfel |
| T-MACH-110376 | Tutorial Mathematical Methods in Continuum Mechanics | 2 CR | Böhlke |

**Competence Certificate**
oral/written exam

**Prerequisites**
None

**Competence Goal**
The students have deepened their knowledge in selected areas of mechanical engineering. Due to the broad variety of eligible courses, they have supplemented / sharpened their own competence profile in mechanical engineering individually and precisely..

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

**Content**
See brick courses.

**Annotation**
Compulsory elective subjects have to be chosen from the corresponding catalogues as displayed in the bachelor´s program with an amount of 4 credit points (see Studienplan or Module Handbook)

**Workload**
The work load is about 120 hours, corresponding to 4 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**
Lectures, Tutorials

# M 7.4 Module: Computer Science (BSc-Modul 09, Inf) [M-MACH-102563]

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

**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 6 | Grade to a tenth | Each summer term | 1 term | German/English | 3 | 2 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-105205 | Computer Science for Engineers | 6 CR | Ovtcharova |
| T-MACH-105206 | Computer Science for Engineers, Prerequisite<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Ovtcharova |

**Competence Certificate**
Written examination "Computer Science for Engineers", 100%, 180 minutes; Examination prerequisite: passed lap course.

**Prerequisites**
None

**Competence Goal**
Students can identify and explain fundamental terms, problems and concepts of computer science. They can apply the basic methods of the OO modeling with UML and implement the object-oriented programming (OOP) with the programming language JAVA.

**Content**
Basics: Information representation- and processing, terms and definitions: alphabet, data, signals, information, numeral systems, propositional logic and Boolean algebra, computer architectures, programming paradigms.
Object Orientation: Definition and important characteristics of object orientation, Object-oriented modeling with UML.
Data Structures: Definition, properties and application of graphs, trees, linked lists, queues and stacks.
Algorithms: Characteristics of algorithms, complexity analysis, design methods, important examples.
Database management systems: Relational data model, relational algebra, declarative language SQL. Basics and concepts of JAVA. Introduction to programming using JAVA.

**Module grade calculation**
Examination result "Computer Science for Engineers" 100%

**Annotation**
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**
Attendance time: 63 hours

Self-study: 117 hours

**Learning type**
Lecture and Lab Course

# M 7.5 Module: Electrical Engineering [M-ETIT-104801]

**Responsible:** Prof. Dr. Martin Doppelbauer
**Organisation:** KIT Department of Electrical Engineering and Information Technology
**Part of:** Fundamentals of Engineering (Usage from 3/8/2019)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 8 | Grade to a tenth | Each winter term | 1 term | German | 3 | 1 |

| Mandatory | | | |
|---|---|---|---|
| T-ETIT-109820 | Electrical Engineering and Electronics | 8 CR | Doppelbauer |

# M 7.6 Module: Engineering Mechanics (BSc-Modul 03, TM) [M-MACH-102572]

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

**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 23 | Grade to a tenth | Each winter term | 4 terms | German/English | 3 | 1 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-100282 | Engineering Mechanics I | 7 CR | Böhlke, Langhoff |
| T-MACH-100283 | Engineering Mechanics II | 6 CR | Böhlke, Langhoff |
| T-MACH-105201 | Engineering Mechanics III & IV | 10 CR | Proppe |
| T-MACH-100528 | Tutorial Engineering Mechanics I<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Böhlke, Langhoff |
| T-MACH-100284 | Tutorial Engineering Mechanics II<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Böhlke, Langhoff |
| T-MACH-105202 | Tutorial Engineering Mechanics III<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Proppe |
| T-MACH-105203 | Tutorial Engineering Mechanics IV<br>*This item will not influence the grade calculation of this parent.* | 0 CR | N.N. |

**Competence Certificate**
Engineering Mechanics I (T-MACH-100282): written exam, 90 minutes, graded. Additives as announced

Engineering Mechanics II (T-MACH-100283): written exam, 90 minutes, graded. Additives as announced

Engineering Mechanics III/IV (T-MACH-105201): written exam, 180 minutes, graded. Additives as announced

Coursework in *Tutorial Engineering Mechanics I* (T-MACH-100528) must be passed for admission to the exam Engineering Mechanics I.

Coursework in *Tutorial Engineering Mechanics II* (T-MACH-100284) must be passed for admission to the exam Engineering Mechanics II.

Coursework in *Tutorial Engineering Mechanics III* (T-MACH-105202) and Coursework in *Tutorial Engineering Mechanics III* (T-MACH-105203) must be passed for admission to the exam Engineering Mechanics III/IV.

**Prerequisites**
None

**Competence Goal**
After completion of this module, the students can

- compute and evaluate 3D stress and strain states within the framework of linear elasticity and thermoelasticity
- apply the principle of virtual displacements
- apply energy methods and evaluate approximate solutions
- evaluate the stability of equilibrium positions
- solve worksheet problems to topics of the lecture using the computer algebra system MAPLE

In EM III and EM IV the students learn to analyse the motion of points and systems. Based on the axioms of Newton and Euler they know how to derive equations of motion. Besides the synthetic methods they get familiar with analytical methods which are based on energy expressions and can be applied efficiently and formalised. These methods are introduced in the scope of systems of mechanical engineering so that students can determine and analyse motions and the forces which are generated by these motions.

**Content**
This Module consists of the courses "Engineering Mechanics I (lecture)" up to "Engineering Mechanics IV (lecture)" as well as "Engineering Mechanics I (Tutorial)" up to "Engineering Mechanics IV (Tutorial)"

Contents of "Engineering Mechanics I": basics of vector calculus; force systems; statics of rigid bodies; internal forces and moments in bars and beams; friction; centre of gravity, centre of mass; work, energy, principle of virtual work; statics of inextensible ropes; elastostatics of tension-compression-bars

Contents of "Engineering Mechanics II": bending; shear; torsion; stress and strain state in 3D; Hooke's law in 3D; elasticity theors in 3D; energy methods in elastostatics; approximation methods; stability

Contents of "Engineering Mechanics III":

Kinematics: Cartesian, cylindrical and natural coordinates. Time derivatives in moving reference frames, angular velocities of reference frames.

Kinetics of a particle:
Newton's axiom, Principle of d'Alembert, work of a force, kinetic and potential energies, principle of linear momentum, principle of moment of momentum, kinetics in moving reference systems

Systems of particles:
Principle of center of mass, Principle of moment of momentum, impacts between particles, systems with variable mass, applications.

Plain motion of rigid bodies:
Pure translation, pure rotation, general plain motion. Instantaneous center of rotation, Kinetics, moment of momentum, principle of work and principle of energy conservation for a rotation around a space-fixed axis. Mass moment of inertia, parallel-axis-theorem.Principle of linear momentum and principle of moment of momentum for arbitrary plain motion. Principle of d'Alembert for plain motion. Principles of linear and moment of momentum in integral form. Applications for impact problems.

Contents of "Engineering Mechanics IV":

Spatial kinematics of a rigid body, Euler angles, angular velocity using Euler angles, Euler's equations, inertia tensor, kinetic energy of a rigid body, free gyroscopes, forced gyroscopes, systems of rigid bodies, principle of d'Alembert, Lagrange's equations of the first and second kind, generalized coordinates, free and forced vibration of one degree of freedom systems, frequency response, vibration of multi degree of freedom systems, vibration absorption

**Module grade calculation**
The final grade of this module is computed as CP-based weighted sum of the included exams.

**Annotation**
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**
lectures and exercises: 204h

homework and preparation of examination: 486h

**Learning type**
Lectures, Tutorials, Lab course groups, attestation of solved work sheets, colloquiua, consultation hours

# M 7.7 Module: Fluid Mechanics (BSc-Modul 12, SL) [M-MACH-102565]

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

**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 8 | Grade to a tenth | Each summer term | 2 terms | German/English | 3 | 1 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-105207 | Fluid Mechanics 1&2 | 8 CR | Frohnapfel |

**Competence Certificate**
Common examination of "Fluid Mechanics I" and "Fluid Mechanics II"; written exam, 3 hours (graded)

**Prerequisites**
none

**Competence Goal**
After having completed this module the student is capable of deriving the mathematical equations that describe the motion of fluids and can determine flow quantities for generic problems. He/she can name characteristic properties of fluids and distinguish different flow states. The student is capable of determining fluid quantities in fundamental applications. This includes the calculation of

- static and dynamic forces acting from the fluid onto the solid
- two-dimensional viscous flows
- one-dimensional incompressible and compressible flows without losses
- lossy flows through pipes

**Content**
properties of fluids, surface tension, hydro- and aerostatics, kinematics, stream tube theory (compressible and incompressible), losses in pipeline systems, dimensional analysis, dimensionless numbers

tensor notation, fluid elements in continuum, Reynolds transport theorem, conservation of mass and momentum, continuity equation, constitutive law for Newtonian fluids, Navier-Stokes equations, angular momentum and energy conservation, integral form of the conservation equations, forces between fluids and solids, analytical solutions of the Navier-Stokes equations

**Module grade calculation**
result of exam

**Annotation**
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**
regular attendance: 64 hoursself-study: 176 hours

**Learning type**
Lectures + tutorials

**Literature**
Zirep J., Bühler, K.: Grundzüge der Strömungslehre, Grundlagen, Statik und Dynamik der Fluide, Springer Vieweg

Kuhlmann, H.: Strömungsmechanik, Pearson Studium

Spurk, J.H.: Strömungslehre, Einführung in die Theorieder Strömungen, Springer-Verlag

Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier 2008

# M 7.8 Module: Key Competencies (BSc-Modul 07, SQL) [M-MACH-102576]

**Responsible:** Prof. Dr.-Ing. Barbara Deml
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Interdisciplinary Qualifications

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 6 | pass/fail | Each term | 1 term | German/English | 3 | 4 |

**Election notes**
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), during Studium Generale at the Forum for Science and Society (FORUM, formerly ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

| **Key Competencies (Election: at least 4 credits)** | | | |
|---|---|---|---|
| T-MACH-110961 | Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example | 2 CR | Grube |
| T-MACH-112935 | Participation in Empirical Research | 2 CR | Deml |
| T-MACH-111684 | Self-Booking-BSc-HOC-SPZ-ZAK-Non-Graded | 2 CR | Heilmaier |
| T-MACH-111685 | Self-Booking-BSc-HOC-SPZ-ZAK-Graded | 2 CR | Heilmaier |
| **Mandatory** | | | |
| T-MACH-112930 | Scientific Work and Empirical Research Methods | 2 CR | Deml |

**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.

**Prerequisites**
none

**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 the principles for ensuring good scientific practice
- 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.

**Content**
The module Key Competences consists "Working Methods in Mechanical Engineering" and a freely selectable courses offered by the KIT-House of Competence (HoC), the KIT Language Centre (SPZ), the Studium Generale at the Forum Wissenschaft und Gesellschaft (FORUM, formerly ZAK), and the brick courses contained in the elective block of key qualifications with a work load corresponding to a total of 2 ECTS.

Upon request, the examination board may approve further courses as freely selectable subjects in the module "Key Competences".

**Module grade calculation**
non graded

**Workload**
The work load is about 180 hours, corresponding to 6 credit points in the Bachelor 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 7.9 Module: Machines and Processes (mach13BSc-Modul 13, MuP) [M-MACH-102566]

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

**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 7 | Grade to a tenth | Each winter term | 1 term | German/English | 3 | 3 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-105208 | Machines and Processes | 7 CR | Bauer, Koch, Kubach, Pritz |
| T-MACH-105232 | Machines and Processes, Prerequisite<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Bauer, Kubach, Maas, Pritz |

**Competence Certificate**
written exam (2 h)

**Prerequisites**
None.

**Competence Goal**
The students can name and describe basic energy conversion processes and energy converting machines. They can explain the application of these energy conversion processes in various machines. They can analyze and evaluate the processes and machines in terms of functionality and efficiency and they are able to solve basic technical problems in terms of operating the machines.

**Content**

- Introduction to power engineering
- Radial and axial turbines
- Pumps
- Compressors
- Blowers
- Wind turbines
- Fuel cells
- Energy storage
- E-motors
- Heat pumps
- Combined heat and power
- Diesel engines
- Gasoline engines
- Hydrogen engines

**Module grade calculation**
Grade out of written exam (100%)

**Annotation**
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**
regular attendance: 48 h

self-study: 162 h

**Learning type**
Lecture+Tutorial

Lab Course

# M 7.10 Module: Major Field: Combustion Engine Techniques (SP 57) [M-MACH-102645]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German | 3 | 7 |

| | | | |
|---|---|---|---|
| **Combustion Engine Techniques (K) (Election: at least 3 credits)** | | | |
| T-MACH-111623 | Fuels and Lubricants for Engine Powertrains | 4 CR | Kehrwald, Kubach |
| T-MACH-110817 | Development of Hybrid Drivetrains | 4 CR | Koch |
| T-MACH-105169 | Engine Measurement Techniques | 4 CR | Bernhardt |
| **Combustion Engine Techniques (E) (Election: at most 1 item)** | | | |
| T-MACH-105173 | Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines | 4 CR | Gohl |
| T-MACH-105649 | Boosting of Combustion Engines | 4 CR | Kech, Kubach |
| T-MACH-110816 | Large Diesel and Gas Engines for Ship Propulsions | 4 CR | Kubach |
| T-MACH-105044 | Fundamentals of Catalytic Exhaust Gas Aftertreatment | 4 CR | Deutschmann, Grunwaldt, Kubach, Lox |
| T-MACH-105337 | Engine Laboratory | 4 CR | Wagner |
| T-MACH-111578 | Sustainable Vehicle Drivetrains | 4 CR | Koch, Toedter |
| T-MACH-111591 | Turbo Charging of Internal Combustion Engines | 4 CR | Kech, Kubach |
| T-MACH-105985 | Ignition Systems | 4 CR | Toedter |
| T-MACH-113265 | Tools for HPC and AI in Engineering | 4 CR | Braun |
| **Mandatory** | | | |
| T-MACH-112799 | Fundamentals of Combustion Engine Technology | 5 CR | Bernhardt, Kubach, Pfeil, Toedter, Wagner |

**Competence Certificate**
oral exam, written exam, lab course reports (see description of bricks)

**Prerequisites**
None

**Competence Goal**
After completition of this „Schwerpunkt“ students are able to

- Describe and explain the working principal of different engine types
- Name the challenges in engine development
- Describe the correlations between engine operation, application parameters and emissions

**Content**
The focus of this “Schwerpunkt” are the basic design and the working principle of internal combustion engines. Different types of engines such as gasoline engine, diesel engine and gas engine are subject. The fundamental thermodynamic aspects as well as the mechanical aspects are discussed. The influence of application parameters and the correlation of engine concepts, fuels and emissions are addressed.

**Workload**
The work load is 360 hours, corresponding to 12 credit points.

**Learning type**
Lectures, Exercises, Lab Courses

# M 7.11 Module: Major Field: Continuum Mechanics (SP 13) [M-MACH-102582]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German | 3 | 6 |

| **Mandatory** | | | |
|---|---|---|---|
| T-MACH-110377 | Continuum Mechanics of Solids and Fluids | 3 CR | Böhlke, Frohnapfel |
| T-MACH-110333 | Tutorial Continuum Mechanics of Solids and Fluids | 1 CR | Böhlke, Frohnapfel |
| T-MACH-110836 | Mathematical Methods in Continuum Mechanics | 4 CR | Böhlke |
| **Continuum Mechanics (E) (Election: )** | | | |
| T-MACH-105320 | Introduction to the Finite Element Method | 3 CR | Böhlke, Langhoff |
| T-MACH-110362 | Introduction to Computational Fluid Dynamics | 3 CR | Frohnapfel, Stroh |
| T-MACH-110330 | Tutorial Introduction to the Finite Element Method | 1 CR | Böhlke, Langhoff |
| T-MACH-111033 | Tutorial Introduction to Computational Fluid Dynamics | 1 CR | Frohnapfel, Stroh |

**Competence Certificate**
see different bricks

**Prerequisites**
none

**Competence Goal**
After having finished this major field the students can

- list important concepts and models of continuum mechanics both for solids and fluids including field equations and boundary conditions
- apply these models in given problems
- apply methods of tensor algebra and tensor analysis in given problems of continuum mechanics
- classify the basic numerical tools and apply them in given problems of continuum mechanics

**Content**
The comprehensive topic of the major field are the basics of continuum mechanics that the students acquire within the compulsory parts (8 credit points). Moreover, there is a supplementary area covering the corresponding numerical methods which the students can choose according to their interests.

**Workload**
The work load is about 360 hours in the Bachelor of Science program, whereof the presence time is 125 h.

**Learning type**
lectures, tutorials, computer tutorial, consultation hours

**Literature**
see different bricks

# M 7.12 Module: Major Field: Energy Converting Engines [M-MACH-102838]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German | 3 | 6 |

| | | | |
|---|---|---|---|
| **Energy Converting Engines (K) (Election: at least 8 credits)** | | | |
| T-MACH-111550 | CO2-Neutral Combustion Engines and their Fuels I | 4 CR | Koch |
| T-MACH-105326 | Hydraulic Fluid Machinery | 8 CR | Pritz |
| T-MACH-105363 | Thermal Turbomachines I | 6 CR | Bauer |
| **Energy Converting Engines (E) (Election: at most 5 credits)** | | | |
| T-CIWVT-105780 | Design of a Jet Engine Combustion Chamber | 6 CR | Harth |
| T-MACH-111623 | Fuels and Lubricants for Engine Powertrains | 4 CR | Kehrwald, Kubach |
| T-MACH-111560 | CO2-Neutral Combustion Engines and their Fuels II | 5 CR | Koch |
| T-MACH-105515 | Introduction to Numerical Fluid Dynamics | 4 CR | Pritz |
| T-MACH-110817 | Development of Hybrid Drivetrains | 4 CR | Koch |
| T-MACH-102093 | Fluid Power Systems | 4 CR | Geimer |
| T-MACH-110816 | Large Diesel and Gas Engines for Ship Propulsions | 4 CR | Kubach |
| 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 |
| T-MACH-105325 | Fundamentals of Combustion II | 4 CR | Bykov, Maas |
| T-MACH-105337 | Engine Laboratory | 4 CR | Wagner |
| T-MACH-111578 | Sustainable Vehicle Drivetrains | 4 CR | Koch, Toedter |
| T-MACH-105338 | Numerical Fluid Mechanics | 4 CR | Gatti, Magagnato |
| T-MACH-105441 | Development of Oil-Hydraulic Powertrain Systems | 4 CR | Geerling |
| T-MACH-105652 | Fundamentals of Combustion Engine Technology | 5 CR | Bernhardt, Kubach, Pfeil, Toedter, Wagner |
| T-MACH-105364 | Thermal Turbomachines II | 6 CR | Bauer |
| T-MACH-105366 | Turbo Jet Engines | 4 CR | Bauer |
| T-MACH-105234 | Windpower | 4 CR | Lewald |
| T-MACH-111591 | Turbo Charging of Internal Combustion Engines | 4 CR | Kech, Kubach |
| T-MACH-111585 | Hydrogen and reFuels - Energy Conversion in Combustion Engines | 4 CR | Kubach |
| T-MACH-105985 | Ignition Systems | 4 CR | Toedter |
| T-MACH-113359 | Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning | 4 CR | Bauer |

**Competence Certificate**
refer to different brick descriptions of SP24

**Prerequisites**
None

**Competence Goal**
The students acquire broad and well-founded knowledge of the scientific theories, principles and methods of engines and work machines in the mandatory part of this major field. The aim is to design, apply and evaluate these machines.

Building on this, the students deepen selected fields of application in the election block, so that they are then able to independently analyze and evaluate problems from this field of application and to develop solutions based on this. After completing the specialization, students can in particular

- name the function and use of engines and working machines,
- describe the state of the art and the resulting fields of application of the engines and work machines and apply them using the example,
- Name the basic theories, methods and properties for the various fields of application of the engines and work machines and use and evaluate them.

**Content**
Energy-converting machines are a core topic in mechanical engineering. This major field deals with the design and functioning of various energy-converting machines. Essentially, this involves hydraulic flow machines, thermal turbo machinery and internal combustion engines. In the election block, additional basics, sub-points and detailed questions of the above machines are treated. The spectrum ranges from basic numerical simulation of the processes to application-oriented project planning and system development.

**Workload**
The work load is 360 hours, corresponding to 12 credit points.

**Recommendation**
Recommended compulsory optional subject: Heat and mass transfer

**Learning type**
Lectures and Exercises

# M 7.13 Module: Major Field: Engineering Design (SP 10) [M-MACH-102815]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German/English | 3 | 9 |

| **Engineering Design (K) (Election: at least 8 credits)** | | | |
|---|---|---|---|
| T-MACH-105216 | Powertrain Systems Technology B: Stationary Machinery | 4 CR | Düser, Ott |
| T-MACH-113405 | Drive System Engineering A: Automotive Systems | 4 CR | Düser, Ott |
| T-MACH-105221 | Lightweight Engineering Design | 4 CR | Düser, Ott |
| **Engineering Design (E) (Election: )** | | | |
| T-MACH-105215 | Applied Tribology in Industrial Product Development | 4 CR | Albers, Lorentz, Matthiesen |
| T-MACH-112717 | Dimensioning of Additive-Manufactured Polymer Structures at an Example from Medical Engineering | 4 CR | Kärger |
| T-MACH-105311 | Design and Development of Mobile Machines | 4 CR | Geimer |
| 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 | Ehrhardt |
| T-MACH-102105 | Manufacturing Technology | 8 CR | Schulze |
| T-MACH-100092 | Automotive Engineering I | 8 CR | Gauterin, Gießler |
| 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-111389 | Fundamentals in the Development of Commercial Vehicles | 4 CR | Weber |
| T-MACH-105162 | Fundamentals of Automobile Development I | 2 CR | Harrer |
| T-MACH-105163 | Fundamentals of Automobile Development II | 2 CR | Harrer |
| T-MACH-112882 | Innovation2Business – Innovation Strategy in the Industrial Corporate Practice | 4 CR | Albers |
| 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-110984 | Production Technology for E-Mobility | 4 CR | Fleischer |
| T-MACH-105441 | Development of Oil-Hydraulic Powertrain Systems | 4 CR | Geerling |
| T-MACH-102107 | Quality Management | 4 CR | Lanza |
| T-MACH-111888 | Re:Invent - Revolutionary Business Models as the Basis for Product Innovations | 4 CR | Schneider |
| 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-111382 | Technical Acoustics | 4 CR | Pantle, Walter |
| T-MACH-105361 | Technical Design in Product Development | 4 CR | Albers, Matthiesen, Schmid |
| T-MACH-102148 | Gear Cutting Technology | 4 CR | Klaiber |

| | | | |
|---|---|---|---|
| T-MACH-110962 | Machine Tools and High-Precision Manufacturing Systems | 8 CR | Fleischer |
| **Engineering Design (P) (Election: at most 4 credits)** | | | |
| T-MACH-105370 | Laboratory Mechatronics<br>*This item will not influence the grade calculation of this parent.* | 4 CR | Hagenmeyer, Stiller |
| T-MACH-111431 | Programming in CAE-Applications | 4 CR | Kärger |
| T-MACH-110960 | Project Internship Additive Manufacturing: Development and Production of an Additive Component | 4 CR | Zanger |
| **Engineering Design (Ü) (Election: )** | | | |
| T-MACH-108887 | Design and Development of Mobile Machines - Advance<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Geimer, Siebert |

**Prerequisites**
None

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

**Content**
see courses of the SP10

**Workload**
The work load is about 360 hours, corresponding to 12 credit points.

**Learning type**
lectures
auditorium exercises
workshops

# M 7.14 Module: Major Field: Fundamentals of Energy Technology [M-MACH-102816]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German/English | 3 | 5 |

| | | | |
|---|---|---|---|
| **Mandatory** | | | |
| T-MACH-105220 | Fundamentals of Energy Technology | 8 CR | Badea, Cheng |
| **Fundamentals of Energy Technology (K) (Election: )** | | | |
| T-MACH-105525 | Introduction to Nuclear Energy | 4 CR | Cheng |
| T-MACH-105325 | Fundamentals of Combustion II | 4 CR | Bykov, Maas |
| T-MACH-105326 | Hydraulic Fluid Machinery | 8 CR | Pritz |
| **Fundamentals of Energy Technology (E) (Election: )** | | | |
| T-MACH-105462 | Selected Problems of Applied Reactor Physics and Exercises | 4 CR | Dagan |
| T-MACH-105151 | Energy Efficient Intralogistic Systems | 4 CR | Kramer, Schönung |
| T-MACH-105408 | Energy Systems I: Renewable Energy | 4 CR | Dagan |
| T-MACH-105557 | Microenergy Technologies | 4 CR | Kohl |
| T-MACH-105338 | Numerical Fluid Mechanics | 4 CR | Gatti, 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 | 4 CR | Dagan |
| T-MACH-110984 | Production Technology for E-Mobility | 4 CR | Fleischer |
| 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-111382 | Technical Acoustics | 4 CR | Pantle, Walter |
| T-MACH-105652 | Fundamentals of Combustion Engine Technology | 5 CR | Bernhardt, Kubach, Pfeil, Toedter, Wagner |
| T-MACH-105225 | Thermal Solar Energy | 4 CR | Dagan |
| T-MACH-105234 | Windpower | 4 CR | Lewald |
| **Fundamentals of Energy Technology (P) (Election: at most 4 credits)** | | | |
| T-MACH-105331 | Laboratory Exercise in Energy Technology<br>*This item will not influence the grade calculation of this parent.* | 4 CR | Bauer, Maas, Wirbser |
| T-MACH-106707 | Workshop on Computer-based Flow Measurement Techniques<br>*This item will not influence the grade calculation of this parent.* | 4 CR | Bauer |

**Competence Certificate**
Oral exam

**Prerequisites**
None

**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.

**Content**
Fundamentals of energy technology offers sound knowledge on the subject of energy conversion, storage and transport as well as the necessary thermodynamic principles. The topics covered include conventional, fossil-fired power plants, combined heat and power generation, nuclear energy, renewable energy sources such as solar energy, wind power and hydropower, as well as energy storage and grid integration. The election block offers opportunities for in-depth study of the listed energy conversion types as well as practical modules in which the fundamentals can be applied in practice. Furthermore, there is the possibility to extend the knowledge of the fundamentals and to get an insight into numerical methods of flow simulation. Progress and challenges of energy system transformation and the latest findings from energy research are also discussed.

**Workload**
360 hours

**Learning type**
Lectures, Tutorials

# M 7.15 Module: Major Field: Information Management (SP 17) [M-MACH-102583]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German | 3 | 6 |

| | | | |
|---|---|---|---|
| **Information Management (K) (Election: at least 8 credits)** | | | |
| T-MACH-106457 | I4.0 Systems Platform | 4 CR | Maier, Ovtcharova |
| T-MACH-105147 | Product Lifecycle Management | 4 CR | Ovtcharova |
| T-MACH-102083 | Integrated Information Systems for Engineers | 4 CR | Ovtcharova |
| **Information Management (E) (Election: )** | | | |
| T-MACH-105212 | CAE-Workshop | 4 CR | Albers, Matthiesen |
| T-MACH-111283 | Development Methods of Technical Systems | 4 CR | Maier, Ovtcharova |
| T-MACH-102209 | Information Engineering | 3 CR | Meyer, Ovtcharova |
| T-MACH-102128 | Information Systems and Supply Chain Management | 3 CR | Kilger |
| T-MACH-112882 | Innovation2Business – Innovation Strategy in the Industrial Corporate Practice | 4 CR | Albers |
| T-MACH-105187 | IT-Fundamentals of Logistics | 4 CR | Thomas |
| T-MACH-105442 | Intellectual Property Rights and Strategies in Industrial Companies | 4 CR | Düser, Zacharias |
| T-MACH-102153 | PLM-CAD Workshop | 4 CR | Ovtcharova |
| T-MACH-102155 | Product, Process and Resource Integration in the Automotive Industry | 4 CR | Mbang |
| T-MACH-105358 | Sustainable Product Engineering | 4 CR | Albers, Matthiesen, Ziegahn |
| T-MACH-102149 | Virtual Reality Practical Course | 4 CR | Ovtcharova |
| **Information Management (P) (Election: at most 4 credits)** | | | |
| T-MACH-102185 | CATIA CAD Training Course | 2 CR | Ovtcharova |
| T-MACH-102187 | CAD-NX Training Course | 2 CR | Ovtcharova |
| T-MACH-113670 | Practical course in robot programming with Python | 4 CR | Rönnau |

**Competence Certificate**
Examination of other kind and oral and/or written examination: duration 2 hours.

**Prerequisites**
None

**Competence Goal**
The students should:

- understand the relevance of information management in product development in consideration of increasing product and process complexity.
- have basic knowledge in handling information, which is generated by product development activities along the lifecycle.

**Content**
Generation and management of information

Architecture and functionality of information systems

CAX-systems, Industry 4.0

**Workload**
360 hours

**Learning type**
Lectures, Tutorials

# M 7.16 Module: Major Field: Information Technology [M-MACH-102817]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German/English | 3 | 5 |

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

| | | | |
|---|---|---|---|
| **Information Technology (K) (Election: at least 8 credits)** | | | |
| T-MACH-105314 | Computational Intelligence | 4 CR | Meisenbacher, Mikut, Reischl |
| T-MACH-105694 | Data Analytics for Engineers | 5 CR | Meisenbacher, 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 |
| **Information Technology (E) (Election: at most 6 credits)** | | | |
| T-MACH-113597 | Decision-Making and Motion Planning for Automated Driving | 6 CR | Naumann, Werling |
| T-MACH-105218 | Automotive Vision | 6 CR | Lauer, Stiller |
| T-MACH-102128 | Information Systems and Supply Chain Management | 3 CR | Kilger |
| T-MACH-105187 | IT-Fundamentals of Logistics | 4 CR | Thomas |
| T-MACH-105169 | Engine Measurement Techniques | 4 CR | Bernhardt |
| T-MACH-111821 | Control of Mobile Machines | 4 CR | Becker, Geimer |
| T-MACH-111820 | Control of Mobile Machines – Prerequisites | 0 CR | Becker, Geimer |
| T-MACH-105185 | Control Technology | 4 CR | Gönnheimer |
| T-MACH-105370 | Laboratory Mechatronics | 4 CR | Hagenmeyer, Stiller |
| T-MACH-105341 | Lab Computer-Aided Methods for Measurement and Control | 4 CR | Klemp, 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.

**Prerequisites**
none

**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.

**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 360 hours, corresponding to 12 credit points.

**Learning type**
lecture, practical training, exercise, prakticat training in laboratory

# M 7.17 Module: Major Field: Materials Science and Engineering (SP 26) [M-MACH-102819]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German/English | 3 | 8 |

**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 |
| **Materials Science and Engineering (E) (Election: )** | | | |
| T-MACH-113412 | Atomistic Simulations and Particle Dynamics | 4 CR | Gumbsch, Schneider, Weygand |
| T-MACH-102141 | Constitution and Properties of Wearresistant Materials | 4 CR | Ulrich |
| T-MACH-105157 | Foundry Technology | 4 CR | Günther, Klan |
| T-MACH-102111 | Principles of Ceramic and Powder Metallurgy Processing | 4 CR | Schell |
| T-MACH-100287 | Introduction to Ceramics | 6 CR | Schell |
| T-MACH-105330 | Design with Plastics | 4 CR | Liedel |
| T-MACH-105164 | Laser in Automotive Engineering | 4 CR | Schneider |
| T-MACH-112763 | Laser Material Processing | 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-102137 | Polymer Engineering I | 4 CR | Liebig |
| T-MACH-110960 | Project Internship Additive Manufacturing: Development and Production of an Additive Component | 4 CR | Zanger |
| T-MACH-105724 | Failure Analysis | 4 CR | Greiner, Schneider |
| T-MACH-105170 | Welding Technology | 4 CR | Farajian |
| T-MACH-112106 | Fatigue of Materials | 4 CR | Guth |
| T-MACH-105970 | Structural Analysis of Composite Laminates | 4 CR | Kärger |
| T-MACH-105362 | Technology of Steel Components | 4 CR | Schulze |
| 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, Schneider |
| T-MACH-111258 | Introduction to High Temperature Materials | 4 CR | Gorr |
| T-MACH-105211 | Materials of Lightweight Construction | 4 CR | Liebig |
| T-MACH-110937 | Materials Recycling and Sustainability | 4 CR | Liebig |
| **Materials Science and Engineering (P) (Election: at most 4 credits)** | | | |
| T-MACH-105651 | Biomechanics: Design in Nature and Inspired by Nature<br>*This item will not influence the grade calculation of this parent.* | 4 CR | Mattheck |
| T-MACH-105447 | Metallographic Lab Class<br>*This item will not influence the grade calculation of this parent.* | 4 CR | Heilmaier, Kauffmann |
| T-MACH-102154 | Laboratory Laser Materials Processing<br>*This item will not influence the grade calculation of this parent.* | 4 CR | Schneider |
| **Materials Science and Engineering (Ü) (Election: )** | | | |
| T-MACH-107685 | Exercises for Materials Characterization<br>*This item will not influence the grade calculation of this parent.* | 2 CR | Gibmeier, 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 individual choice.

**Prerequisites**
None

**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.

**Content**
The comprehensive topic of the major field are the thermodynamical and kinetic basics of materials science that the students acquire within the compulsory parts (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 12 credit points in the bachelor´s program. Within the compulsory parts, at least 8 credits are to be chosen. Within the supplementary area, the students can select from a broad variation of courses. For the bachelor´s program, a reduced catalogue exists (see Studienplan).

**Workload**
The work load is about 360 hours in the Bachelor of Science program, whereof the presence time is 66 h.

**Learning type**
Within the compulsory parts 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 7.18 Module: Major Field: Mechatronics (SP 31) [M-MACH-102820]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German/English | 3 | 9 |

| | | | |
|---|---|---|---|
| **Mechatronics (K) (Election: at least 8 credits)** | | | |
| T-MACH-105314 | Computational Intelligence | 4 CR | Meisenbacher, Mikut, Reischl |
| T-MACH-105694 | Data Analytics for Engineers | 5 CR | Meisenbacher, Mikut, Reischl |
| T-MACH-113597 | Decision-Making and Motion Planning for Automated Driving | 6 CR | Naumann, Werling |
| T-MACH-100535 | Introduction into Mechatronics | 6 CR | Orth, Reischl |
| T-MACH-105209 | Introduction to Multi-Body Dynamics | 5 CR | Römer |
| T-MACH-105218 | Automotive Vision | 6 CR | Lauer, Stiller |
| T-MACH-105539 | Modern Control Concepts I | 4 CR | Groell, Matthes |
| **Mechatronics (E) (Election: at most 1 item)** | | | |
| T-MACH-112717 | Dimensioning of Additive-Manufactured Polymer Structures at an Example from Medical Engineering | 4 CR | Kärger |
| T-MACH-108844 | Automated Manufacturing Systems | 8 CR | Fleischer |
| 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 | Doppelbauer |
| T-MACH-112882 | Innovation2Business – Innovation Strategy in the Industrial Corporate Practice | 4 CR | Albers |
| T-MACH-105187 | IT-Fundamentals of Logistics | 4 CR | Thomas |
| T-MACH-105210 | Machine Dynamics | 5 CR | Proppe |
| T-MACH-105224 | Machine Dynamics II | 4 CR | Proppe |
| T-MACH-105294 | Mathematical Methods of Vibration Theory | 6 CR | Fidlin, Höllig, Römer |
| T-MACH-105334 | Mechanics in Microtechnology | 4 CR | Greiner, Gruber |
| T-MACH-105370 | Laboratory Mechatronics | 4 CR | Hagenmeyer, Stiller |
| T-INFO-101266 | Human-Machine-Interaction | 6 CR | Beigl |
| T-MACH-105335 | Measurement II | 4 CR | Stiller |
| T-MACH-105557 | Microenergy Technologies | 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 | Düser, Zacharias |
| T-MACH-108878 | Laboratory Production Metrology | 4 CR | Lanza, Stamer |
| T-INFO-108014 | Robotics I - Introduction to Robotics | 6 CR | Asfour |
| T-MACH-105373 | Practical Training in Measurement of Vibrations | 4 CR | Fidlin |
| T-ETIT-112860 | Signals and Systems | 7 CR | Kluwe, Wahls |
| T-MACH-105372 | Theory of Stability | 6 CR | Fidlin |
| T-MACH-111821 | Control of Mobile Machines | 4 CR | Becker, Geimer |
| T-MACH-111820 | Control of Mobile Machines – Prerequisites | 0 CR | Becker, Geimer |
| 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-110272 | System Integration in Micro- and Nanotechnology 2 | 4 CR | Gengenbach |

| | | | |
|---|---|---|---|
| T-MACH-105290 | Vibration Theory | 5 CR | Fidlin |
| T-MACH-102149 | Virtual Reality Practical Course | 4 CR | Ovtcharova |
| **Mechatronics (Ü) (Election: )** | | | |
| T-MACH-108889 | BUS-Controls - Advance<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Geimer |
| T-INFO-106257 | Human-Machine-Interaction Pass<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Beigl |

**Competence Certificate**
Written exam and oral exam.

**Prerequisites**
none

**Competence Goal**
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.

**Content**
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.

**Workload**
The work load is about 360 hours, corresponding to 12 credit points.

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

# M 7.19 Module: Major Field: Modeling and Simulation in Dynamics (SP 61) [M-MACH-104430]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German | 3 | 5 |

| | | | |
|---|---|---|---|
| **Modeling and Simulation in Dynamics (K) (Election: at least 8 credits)** | | | |
| T-MACH-105226 | Dynamics of the Automotive Drive Train | 5 CR | Fidlin |
| T-MACH-105209 | Introduction to Multi-Body Dynamics | 5 CR | Römer |
| T-MACH-105210 | Machine Dynamics | 5 CR | Proppe |
| T-MACH-105293 | Mathematical Methods in Dynamics | 6 CR | Proppe |
| T-MACH-105290 | Vibration Theory | 5 CR | Fidlin |
| **Modeling and Simulation in Dynamics (E) (Election: at most 5 credits)** | | | |
| T-MACH-111260 | Dynamics of Electro-Mechanical Systems | 5 CR | Altoé, Fidlin |
| T-MACH-105514 | Experimental Dynamics | 5 CR | Fidlin |
| T-MACH-105224 | Machine Dynamics II | 4 CR | Proppe |
| T-MACH-105294 | Mathematical Methods of Vibration Theory | 6 CR | Fidlin, Höllig, Römer |
| T-MACH-105349 | Computational Dynamics | 4 CR | Proppe |
| T-MACH-105350 | Computational Vehicle Dynamics | 4 CR | Proppe |
| T-MACH-105172 | Simulation of Coupled Systems | 4 CR | Geimer |
| T-MACH-108888 | Simulation of Coupled Systems - Advance<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Geimer |
| T-MACH-113412 | Atomistic Simulations and Particle Dynamics | 4 CR | Gumbsch, Schneider, Weygand |

**Competence Certificate**
oral examination

**Prerequisites**
None

**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.

**Content**
This module deals with procedures, methods and applications for mechanical dynamical systems. Subjects are different methods to describe kinematics of multibody systems and to derive the equations of motion for such systems. Solutions of the equations of motion are obtained analytically by mathematical methods or approximately by numerical integration. Applications range from industrial systems like machines and cars down to atomistic simulation.

**Workload**
360 h

**Learning type**
Lectures, tutorials

# M 7.20 Module: Major Field: Powertrain Systems (SP 02) [M-MACH-102812]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German/English | 3 | 6 |

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

| | | | |
|---|---|---|---|
| **Powertrain Systems (K) (Election: at least 8 credits)** | | | |
| T-MACH-105307 | Drive Train of Mobile Machines | 4 CR | Geimer |
| T-MACH-105216 | Powertrain Systems Technology B: Stationary Machinery | 4 CR | Düser, Ott |
| T-MACH-113405 | Drive System Engineering A: Automotive Systems | 4 CR | Düser, Ott |
| T-MACH-105226 | Dynamics of the Automotive Drive Train | 5 CR | Fidlin |
| **Powertrain Systems (E) (Election: )** | | | |
| T-MACH-105215 | Applied Tribology in Industrial Product Development | 4 CR | Albers, Lorentz, Matthiesen |
| T-MACH-110958 | Design and Optimization of Conventional and Electrified Automotive Transmissions | 4 CR | Albers, Faust |
| T-MACH-105209 | Introduction to Multi-Body Dynamics | 5 CR | Römer |
| T-MACH-105151 | Energy Efficient Intralogistic Systems | 4 CR | Kramer, Schönung |
| T-ETIT-100784 | Hybrid and Electric Vehicles | 4 CR | Doppelbauer |
| T-MACH-112882 | Innovation2Business – Innovation Strategy in the Industrial Corporate Practice | 4 CR | Albers |
| T-MACH-105187 | IT-Fundamentals of Logistics | 4 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 | Düser, Zacharias |
| T-MACH-110984 | Production Technology for E-Mobility | 4 CR | Fleischer |
| T-MACH-105441 | Development of Oil-Hydraulic Powertrain Systems | 4 CR | Geerling |
| T-MACH-111821 | Control of Mobile Machines | 4 CR | Becker, Geimer |
| T-MACH-111820 | Control of Mobile Machines – Prerequisites | 0 CR | Becker, Geimer |
| 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 |
| T-MACH-102148 | Gear Cutting Technology | 4 CR | Klaiber |
| **Powertrain Systems (Ü) (Election: )** | | | |
| T-MACH-109303 | Exercices - Tribology<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Dienwiebel |

**Prerequisites**
none

**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.

**Content**
See courses of the SP02

**Workload**
The work load is about 360 hours, corresponding to 12 credit points.

**Learning type**
lectures
auditorium exercises
workshops

# M 7.21 Module: Major Field: Production Systems (SP 38) [M-MACH-102589]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German | 3 | 5 |

| | | | |
|---|---|---|---|
| **Production Systems (K) (Election: at least 8 credits)** | | | |
| T-MACH-105518 | Human Factors Engineering I | 4 CR | Deml |
| T-MACH-105519 | Human Factors Engineering II | 4 CR | Deml |
| T-MACH-102105 | Manufacturing Technology | 8 CR | Schulze |
| T-MACH-108849 | Integrated Production Planning in the Age of Industry 4.0 | 8 CR | Lanza |
| T-MACH-110962 | Machine Tools and High-Precision Manufacturing Systems | 8 CR | Fleischer |
| **Production Systems (E) (Election: )** | | | |
| T-MACH-108844 | Automated Manufacturing Systems | 8 CR | Fleischer |
| T-MACH-105147 | Product Lifecycle Management | 4 CR | Ovtcharova |
| T-MACH-102107 | Quality Management | 4 CR | Lanza |
| T-MACH-102083 | Integrated Information Systems for Engineers | 4 CR | Ovtcharova |
| **Production Systems (P) (Election: at most 4 credits)** | | | |
| T-MACH-108878 | Laboratory Production Metrology | 4 CR | Lanza, Stamer |
| T-MACH-110960 | Project Internship Additive Manufacturing: Development and Production of an Additive Component | 4 CR | Zanger |

**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.

**Prerequisites**
None

**Competence Goal**
The students...

- are able to choose methods of production science target-oriented in familiar situations and are able to justify their selection.
- are able to describe and compare production processes exemplarily.
- are able to transfer known solutions to given problems 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 results of others at the solution of given problems.
- have the ability to present their own results in written form and are able to interpret them.
- 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.

**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 360 hours, corresponding to 12 credit points.

**Learning type**
Lectures, seminars, workshops, excursions

# M 7.22 Module: Major Field: Rail System Technology (SP 50) [M-MACH-102638]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German | 3 | 4 |

| | | | |
|---|---|---|---|
| **Mandatory** | | | |
| T-MACH-106424 | Rail System Technology | 4 CR | Cichon |
| T-MACH-105353 | Rail Vehicle Technology | 4 CR | Cichon |
| **Rail System Technology (E) (Election: )** | | | |
| T-MACH-105540 | Railways in the Transportation Market | 4 CR | Cichon |
| T-MACH-113016 | Digitization in the Railway System | 4 CR | Cichon |
| T-MACH-105237 | Vehicle Lightweight Design - Strategies, Concepts, Materials | 4 CR | Henning |
| T-MACH-105218 | Automotive Vision | 6 CR | Lauer, Stiller |
| T-MACH-113069 | Vehicle Systems for Urban Mobility | 4 CR | Cichon |
| T-MACH-105535 | Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies | 4 CR | Henning |
| T-MACH-113068 | Innovation and Project Management in Rail Vehicle Engineering | 4 CR | Cichon |
| T-MACH-105350 | Computational Vehicle Dynamics | 4 CR | Proppe |
| T-MACH-108692 | Seminar for Rail System Technology | 3 CR | Cichon |

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

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

**Prerequisites**
None

**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.

**Content**

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations
8. Vehicle system technology: structure and main systems of rail vehicles
9. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
10. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
11. Drives: priciples, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisystem vehicles, dual mode vehicles, hybrid vehicles), non-electric drives
12. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
13. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends
14. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck vehicles, locomotives, freight wagons
15. Further contents in supplementary lectures

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

**Workload**

- Total effort at 12 ECTS (B.Sc.): about 360 hours
- Regular attendance: 63 hours
- Self-study: 63 hours
- Exam and preparation: 234 hours

**Learning type**
Lectures in the core part.

Lectures and seminars are offered in the supplementary part.

# M 7.23 Module: Major Field: Technical Logistics (SP 44) [M-MACH-102821]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German | 3 | 6 |

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

| | | | |
|---|---|---|---|
| **Technical Logistics (K) (Election: at least 8 credits)** | | | |
| T-MACH-112113 | Dynamic Systems of Technical Logistics | 6 CR | Mittwollen |
| T-MACH-112841 | Basics of Technical Logistics I | 4 CR | Mittwollen, Oellerich |
| T-MACH-109920 | Basics of Technical Logistics II | 6 CR | Furmans |
| **Technical Logistics (E) (Election: )** | | | |
| T-MACH-112114 | Dynamic Systems of Technical Logistics - Project | 4 CR | Mittwollen |
| T-MACH-105151 | Energy Efficient Intralogistic Systems | 4 CR | Kramer, Schönung |
| T-MACH-105187 | IT-Fundamentals of Logistics | 4 CR | Thomas |
| T-MACH-105174 | Warehousing and Distribution Systems | 3 CR | Furmans |
| T-MACH-105175 | Airport Logistics | 3 CR | Richter |
| T-MACH-105171 | Safety Engineering | 4 CR | Kany |
| T-MACH-108844 | Automated Manufacturing Systems | 8 CR | Fleischer |
| T-MACH-113597 | Decision-Making and Motion Planning for Automated Driving | 6 CR | Naumann, Werling |
| T-MACH-105378 | Cognitive Automobiles - Laboratory | 6 CR | Kitt, Lauer, Stiller |
| T-MACH-102107 | Quality Management | 4 CR | Lanza |

**Competence Certificate**
Written and oral exams, see brick courses

**Prerequisites**
None

**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.

**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 360 hours, corresponding to 12 credit points.

**Learning type**
Lectures and practices; self-study

# M 7.24 Module: Major Field: Vehicle Technology (SP 12) [M-MACH-102818]

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

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German/English | 3 | 9 |

| | | | |
|---|---|---|---|
| **Mandatory** | | | |
| T-MACH-100092 | Automotive Engineering I | 8 CR | Gauterin, Gießler |
| **Automotive Technology (E) (Election: )** | | | |
| T-MACH-105655 | Alternative Powertrain for Automobiles | 4 CR | Noreikat |
| T-MACH-110958 | Design and Optimization of Conventional and Electrified Automotive Transmissions | 4 CR | Albers, Faust |
| T-MACH-108844 | Automated Manufacturing Systems | 8 CR | Fleischer |
| T-MACH-111550 | CO2-Neutral Combustion Engines and their Fuels I | 4 CR | Koch |
| T-MACH-111560 | CO2-Neutral Combustion Engines and their Fuels II | 5 CR | Koch |
| T-MACH-105226 | Dynamics of the Automotive Drive Train | 5 CR | Fidlin |
| T-MACH-110817 | Development of Hybrid Drivetrains | 4 CR | Koch |
| 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 | Ehrhardt |
| T-MACH-105237 | Vehicle Lightweight Design - Strategies, Concepts, Materials | 4 CR | Henning |
| 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, Gießler |
| 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-111389 | Fundamentals in the Development of Commercial Vehicles | 4 CR | Weber |
| T-ETIT-100784 | Hybrid and Electric Vehicles | 4 CR | Doppelbauer |
| T-MACH-105375 | Industrial Aerodynamics | 4 CR | Frohnapfel, Kröber |
| T-MACH-112882 | Innovation2Business – Innovation Strategy in the Industrial Corporate Practice | 4 CR | Albers |
| T-MACH-105188 | Integrative Strategies in Production and Development of High Performance Cars | 4 CR | Schlichtenmayer |
| T-MACH-105221 | Lightweight Engineering Design | 4 CR | Düser, Ott |
| T-MACH-105164 | Laser in Automotive Engineering | 4 CR | Schneider |
| T-MACH-112763 | Laser Material Processing | 4 CR | Schneider |
| T-MACH-110954 | Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice | 4 CR | Kärger, Liebig |
| T-MACH-105169 | Engine Measurement Techniques | 4 CR | Bernhardt |
| T-MACH-111578 | Sustainable Vehicle Drivetrains | 4 CR | Koch, Toedter |
| T-MACH-105442 | Intellectual Property Rights and Strategies in Industrial Companies | 4 CR | Düser, Zacharias |
| T-MACH-110984 | Production Technology for E-Mobility | 4 CR | Fleischer |
| T-MACH-110318 | Product- and Production-Concepts for Modern Automobiles | 4 CR | Kienzle, Steegmüller |

| | | | |
|---|---|---|---|
| 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-110796 | Python Algorithm for Vehicle Technology | 4 CR | Rhode |
| T-MACH-105441 | Development of Oil-Hydraulic Powertrain Systems | 4 CR | Geerling |
| 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-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-105652 | Fundamentals of Combustion Engine Technology | 5 CR | Bernhardt, Kubach, Pfeil, Toedter, Wagner |
| T-MACH-102194 | Combustion Engines I | 4 CR | Koch, Kubach |
| T-MACH-102148 | Gear Cutting Technology | 4 CR | Klaiber |
| T-MACH-111585 | Hydrogen and reFuels - Energy Conversion in Combustion Engines | 4 CR | Kubach |
| T-MACH-112126 | Data-Driven Algorithms in Vehicle Technology | 4 CR | Scheubner |
| T-MACH-113597 | Decision-Making and Motion Planning for Automated Driving | 6 CR | Naumann, Werling |
| T-MACH-113405 | Drive System Engineering A: Automotive Systems | 4 CR | Düser, Ott |
| T-MACH-105162 | Fundamentals of Automobile Development I | 2 CR | Harrer |
| T-MACH-105163 | Fundamentals of Automobile Development II | 2 CR | Harrer |

**Competence Certificate**
Valid for all degree programmes, for which no value is indicated in the following.

The assessment is carried out as partial exams of the single courses of this module, whose sum of credits must meet the minimum requirement of credits of this module. The assessment procedures are described for each course of the module separately. Amount, type and scope of the success controll can vary according to the individually choice. Oral exams: duration approx. 5 min. per credit point. Within the scope of lab courses maximum 4 credits may be aquired.

The overall grade of the module is the average of the grades for each course weighted by the credits and truncated after the first decimal.

**Prerequisites**
None

**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.

**Content**
In the module Automotive Technology the basics are taught, which are important for the development, the design, the production and the operation of vehicles. Particularly the primary important aggregates like engine, gear, drive train, chasis and auxiliary equipment are explained, but also all technical equipment, which make the operation safer and easier. Additionally the interior equipment is examined, which shall provide a preferably comfortable, optimum ambience to the user.

In the module Automotive Technology the focus is on passenger cars and commercial vehicles, which are designed for road applications.

**Workload**
The work load is about 360 hours, corresponding to 12 credit points.

**Learning type**
The teaching and learning procedures (lecture, lab course, workshop) are described for each course of the module separately.

# M 7.25 Module: Major Field: Vibration Theory [M-MACH-104442]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Specialization in Mechanical Engineering (Major Field)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 12 | Grade to a tenth | Each term | 2 terms | German | 3 | 4 |

| | | | |
|---|---|---|---|
| **Vibration Theory (K) (Election: at least 8 credits)** | | | |
| T-MACH-105439 | Introduction to Nonlinear Vibrations | 7 CR | Fidlin |
| T-MACH-105210 | Machine Dynamics | 5 CR | Proppe |
| T-MACH-105294 | Mathematical Methods of Vibration Theory | 6 CR | Fidlin, Höllig, Römer |
| T-MACH-105372 | Theory of Stability | 6 CR | Fidlin |
| T-MACH-105290 | Vibration Theory | 5 CR | Fidlin |
| **Vibration Theory (E) (Election: at most 4 credits)** | | | |
| T-MACH-105226 | Dynamics of the Automotive Drive Train | 5 CR | Fidlin |
| T-MACH-111260 | Dynamics of Electro-Mechanical Systems | 5 CR | Altoé, Fidlin |
| T-MACH-105224 | Machine Dynamics II | 4 CR | Proppe |
| T-MACH-105349 | Computational Dynamics | 4 CR | Proppe |
| T-MACH-105373 | Practical Training in Measurement of Vibrations | 4 CR | Fidlin |
| T-MACH-105514 | Experimental Dynamics | 5 CR | Fidlin |

**Competence Certificate**
oral examination

**Prerequisites**
None

**Content**
The students know different methods which may be applied for the analysis of investigation of vibration problems. They are able to treat one or multiple degree 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.

# M 7.26 Module: Manufacturing Processes [M-MACH-102549]

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

**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 4 | Grade to a tenth | Each winter term | 1 term | German | 3 | 1 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-105219 | Basics of Manufacturing Technology | 4 CR | Schulze |

**Competence Certificate**
written exam (duration: 60 min)

**Prerequisites**
none

**Competence Goal**
The students …

- are able to classify the manufacturing processes by their general functionality according to the specific main groups (DIN 8580).
- have the ability to declare and explain the function of the significant manufacturing processes of the main groups (DIN 8580).
- are enabled to describe the characteristic process features (geometry, materials, accuracy, tools, machines) of the significant manufacturing processes of the main groups (DIN 8580).
- have the ability to derive the relevant process specific technical advantages and disadvantages of the characteristic process features.
- are enabled to perform a selection of suitable manufacturing processes for given components.
- are enabled to classify the required manufacturing processes in the expiry of a process chain for the production of given sample products.

**Content**
The objective of the lecture is to classify the manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to establish basic process knowledge of the common processes. The lecture conveys the basic principles of manufacturing technology and deals with the manufacturing processes based on example components according to their classification into main groups regarding technical and economic aspects.

The following topics will be covered:

- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment

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

**Learning type**
Lecture

# M 7.27 Module: Materials Science (BSc-Modul 04, WK) [M-MACH-102562]

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

**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 14 | Grade to a tenth | Each winter term | 2 terms | German/English | 3 | 3 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-105145 | Materials Science I & II | 11 CR | Gibmeier, Heilmaier, Pundt |
| T-MACH-105146 | Materials Science Lab Course | 3 CR | Gibmeier, Heilmaier, Pundt |

**Competence Certificate**
not graded: participation in 10 lab experiments, introductory colloquia must be passed and 1 short presentation must be presented. The lab course must be finished successfully prior to the registration for the oral exam;

graded: oral exam covering the whole module, about 25 minutes.

**Prerequisites**
none

**Competence Goal**
Within this Module the students should

- gain knowledge of basics about structural and functional materials
- be able to draw relationships between atomic structure, microstructure and properties
- be able to apply appropriate methods to determine mechanical and other relevant properties as well as to characterize the microstructure of materials
- be able to assess material properties and corresponding applications

**Content**
WK I

Structure of atoms and atomic bonding

Crystalline solids

Defects in crystalline solids

Amorphous and partially crystalline solids

Constitution of alloys and materials

Diffusion and phase transformation in the solid state

Microscopic characterization method

Characterization with X-Rays and neutrons

Non-destructive Testing

Mechanical Testing

WK II

Iron based alloys

Non-iron based alloys

Ceramics

Glases

Polymers

Composite Materials

**Annotation**
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**
The work load of the module is about 420 hours.

The workload for the lab course Materials Science is 90 h in total and consists of the presence during the 10 experiments (one week half-time, 4 hours per day) as well as preparation and rework time at home.

The workload for the lecture Materials Science I & II is 165 h per semester and consists of the presence during the lectures (WS: 4 SWS, SS: 2SWS) and the exercises (1 SWS per WS and 1 SWS per SS) as well as preparation and rework time at home.

**Learning type**
**The module "Materials Science" consists of the lectures "Materials Science I and II" with additional tutorials for small groups and a one week materials science laboratory course.**

# M 7.28 Module: Measurement and Control Systems (BSc-Modul 11, MRT) [M-MACH-102564]

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

**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 7 | Grade to a tenth | Each winter term | 1 term | German/English | 3 | 2 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-104745 | Basics in Measurement and Control Systems | 7 CR | Stiller |

**Competence Certificate**
Type of Examination: written exam

Duration of Examination: 150 minutes

**Prerequisites**
none

**Competence Goal**

- Students are able to name, describe and explain control principles applied to physical quantities.
- They are able to name, analyze and assess system theoretic characteristics of dynamical systems.
- Students are able to represent real systems in a system theoretic model and to assess the suitability of a given model.
- Students are able to apply methods for controller design and to analyze their properties.
- Students are able to select appropriate principles of metrology and to model, analyze and assess measurement setups.
- Students are able to quantify and assess measurement uncertainties.

**Content**
1. Dynamic systems
2. Properties of important systems and modeling
3. Transfer characteristics and stability
4. Controller design
5. Fundamentals of measurement
6. Estimation
7. Sensors
8. Introduction to digital measurement

**Module grade calculation**
result of exam

**Annotation**
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**
84 hours presence time, 126 hours selfstudies

**Recommendation**
Fundamentals in physics and electrical engineering, ordinary linear diffential epuations, Laplace transform

**Learning type**
Lecture

Tutorials

**Literature**

Buch zur Vorlesung:
C. Stiller: Grundlagen der Mess- und Regelungstechnik, Shaker Verlag, Aachen, 2005

- Measurement and Control Systems:

R.H. Cannon: Dynamics of Physical Systems, McGraw-Hill Book Comp., New York, 1967
G.F. Franklin: Feedback Control of Dynamic Systems, Addison-Wesley Publishing Company, USA, 1988
R. Dorf and R. Bishop: Modern Control Systems, Addison-Wesley
C. Phillips and R. Harbor: Feedback Control Systems, Prentice-Hall

- Regelungstechnische Bücher:

J. Lunze: Regelungstechnik 1 & 2, Springer-Verlag
R. Unbehauen: Regelungstechnik 1 & 2, Vieweg-Verlag
O. Föllinger: Regelungstechnik, Hüthig-Verlag
W. Leonhard: Einführung in die Regelungstechnik, Teubner-Verlag
Schmidt, G.: Grundlagen der Regelungstechnik, Springer-Verlag, 2. Aufl., 1989

- Messtechnische Bücher:

E. Schrüfer: Elektrische Meßtechnik, Hanser-Verlag, München, 5. Aufl., 1992
U. Kiencke, H. Kronmüller, R. Eger: Meßtechnik, Springer-Verlag, 5. Aufl., 2001
H.-R. Tränkler: Taschenbuch der Messtechnik, Verlag Oldenbourg München, 1996
W. Pfeiffer: Elektrische Messtechnik, VDE Verlag Berlin 1999
Kronmüller, H.: Prinzipien der Prozeßmeßtechnik 2, Schnäcker-Verlag, Karlsruhe, 1. Aufl., 1980

Measurement and Control Systems

# M 7.29 Module: Mechanical Design (BSc-Modul 06, MKL) [M-MACH-102573]

**Responsible:** Prof. Dr.-Ing. Sven Matthiesen
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 20 | Grade to a tenth | Each winter term | 4 terms | German/English | 3 | 4 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-105286 | Mechanical Design I and II | 5 CR | Matthiesen |
| T-MACH-104810 | Mechanical Design III and IV | 11 CR | Matthiesen |
| T-MACH-105282 | Mechanical Design I, Prerequisites<br>*This item will not influence the grade calculation of this parent.* | 1 CR | Matthiesen |
| T-MACH-105283 | Mechanical Design II, Prerequisites<br>*This item will not influence the grade calculation of this parent.* | 1 CR | Matthiesen |
| T-MACH-110955 | Mechanical Design III, Tutorial | 1 CR | Matthiesen |
| T-MACH-110956 | Mechanical Design IV, Tutorial | 1 CR | Matthiesen |

**Competence Certificate**
**Mechanical Design I and II:**

Preliminary examination: Successful participation in workshops in the field of mechanical Design I, as well as successful processing of output power in mechanical design II

Written examination in the field of mechanical engineering I and II: duration 90 min plus reading time

**Mechanical Design III and IV:**

Preliminary examination: Successful participation in workshops in the field of mechanical Design III & IV

- Examination in the field of mechanical Design III & IV consisting of
  written part with duration 60 min plus reading time and
- constructive part with duration 180 min plus reading ime

**Prerequisites**
None

**Competence Goal**
In mechanical design, students acquire skills in analysis and synthesis using examples (= leading examples). The examples include individual machine elements such as bearings or springs as well as more complex systems such as gears or clutches. After completing the machine design course, the students can apply the learned contents to further technical systems - even those not known from the lecture - by transferring the exemplary learned operating principles and basic functions to other contexts. This enables students to independently analyze unknown technical systems and to synthesize systems suitable for given problems.

**Content**
**MKL I:**

- Introduction to product development
- Springs
- Tools for visualization (technical drawing)
- Technical systems
- Bearings and guides

**MKL II:**

- Basics of the design
- Basics of screw connections
- Basics Seals

**MKL III:**

- Component connections
- Tolerances and clearance
- Transmission

**MKL IV:**

- Clutches
- Fluid Technology
- Dimensioning
- Electrical machines

**Annotation**
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**
**MKL1:**

**presence: 33,5 h**

Attendance in lectures: 15 * 1.5 h = 22.5 h

Presence in exercises: 8 * 1.5 h = 12 h

**self-study: 56,5 h**

Personal preparation and wrap-up of lecture and exercises including the processing of the test certificates and preparation for the exam: 56.5 h

**Total: 90 h = 3 LP**

**MKL2:**

**Presence: 33 h**

Attendance in lectures: 15 * 1.5 h = 22.5 h

Presence in exercises: 7 * 1.5 h = 10.5 h

**Self study: 87 h**

Personal preparation and wrap-up of lectures and exercises, including the processing of the test certificates and preparation for the exam: 87h

**Total: 120 h = 4 LP**

**MKL 3:**

**Presence: 45h**

Attendance lectures (15 L): 22,5h

Presence exercises (7 exercises): 10,5h

Attendance milestones project work (3x 4h): 12h

**Self-study: 135h**

Project work in a team: 90h

Personal preparation and follow-up of lecture and exercise: 45h

**Total: 180 h = 6 LP**

**MKL 4:**

**Presence: 40,5h**

Attendance lectures (13 L): 19,5h

Presence exercises (6 exercises): 9h

Attendance milestones project work (3x 4h): 12h

**Self-study: 169,5h**

Project work in a team: 105h

Personal preparation and follow-up of lecture and exercise, incl. preparation for the exam: 64,5h

**Total: 210 h = 7 LP**

**Learning type**
Lecture

Tutorial

Project work during the semester

# M 7.30 Module: Orientation Exam [M-MACH-104624]

**Organisation:** University
**Part of:** Orientation Exam

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 0 | pass/fail | Each term | 2 terms | German | 3 | 1 |

| **Mandatory** | | | |
|---|---|---|---|
| T-MATH-100275 | Advanced Mathematics I | 7 CR | Arens, Griesmaier, Hettlich |
| T-MACH-100282 | Engineering Mechanics I | 7 CR | Böhlke, Langhoff |
| T-MACH-100283 | Engineering Mechanics II | 6 CR | Böhlke, Langhoff |

**Modelled deadline**
This module must be passed until the end of the **3. term**.

# M 7.31 Module: Physics [M-PHYS-104030]

**Responsible:** apl. Prof. Dr. Gernot Goll
apl. Prof. Dr. Bernd Pilawa
**Organisation:** KIT Department of Physics
**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 5 | Grade to a tenth | Each summer term | 1 term | German/English | 3 | 1 |

| Mandatory | | | |
|---|---|---|---|
| T-PHYS-108322 | Wave and Quantum Physics | 5 CR | Goll, Pilawa |

**Competence Certificate**
The assessment consists of a written exam according to Section 4(2), 1 of the examination regulation.

**Prerequisites**
None

**Competence Goal**
The students

- are familiar with the properties of waves and can discuss those
- can reflect on the principles of relativity
- comprehend the coherence of the particle and wave description of light and matter
- can explain the limits of wave physics
- are able the apply the Schrödinger-equation to basic problems in quantum mechanics
- can explain the basic properties of atoms, especially for the hydrogen atom
- can discuss fundamental aspects of the electronic properties of solids

**Content**

- Properties of waves
- Acoustic and electromagnetic waves
- Interference and diffraction
- Relativity
- Wave-particle dualism
- Basic properties of atoms
- Basic electronic properties of solids

**Annotation**
For the Bachelor's program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor's program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**
150 hours, consisting of attendance times (45), follow-up of the lecture including exam preparation and preparation of exercises (105)

**Learning type**
Lecture and Tutorial

# M 7.32 Module: Supplementary Studies on Science, Technology and Society [M-FORUM-106753]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**

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

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

**Election notes**
Students have to self-record the achievements obtained in the Supplementary Studies on Science, Technology and Society in their study plan. FORUM (formerly ZAK) records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the FORUM homepage at https://www.zak.kit.edu/english/16495.php. The title of the examination and the amount of credits override the modules placeholders.

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

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

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

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

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

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

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

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

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

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

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

The Advanced Module is divided into 3 thematic subject areas:

**Subject area 1: About Knowledge and Science**

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

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

**Subject area 2: Science in Society**

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

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

**Subject area 3: Science in Public Debates**

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

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

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

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

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

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

Additional credit points (supplementary achievements), up to a maximum of 12, can be earned from interdisciplinary achievements and can be included in the supplementary course. Upon request, these supplementary achievements are listed in the certificate of the accompanying course, marked as such, and recorded with their grades as specified in paragraph 9. However, these supplementary achievements are **not** included in the calculation of the overall grade for the accompanying course.
The statutes for the accompanying study programme Science, Technology and Society apply.

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

- Basic Module approx. 120 hours
- Advanced Module approx. 390 hours
> Total: approx. 510 hours

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

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

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

**Learning type**
- Lectures
- Seminars/Project Seminars
- Workshops

# M 7.33 Module: Sustainable Production Economics (BSc-Modul 22 MWT) [M-MACH-105902]

**Responsible:** Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Gisela Lanza
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** Fundamentals of Engineering (Usage from 10/1/2022)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 5 | Grade to a tenth | Each winter term | 1 term | German | 3 | 2 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-111859 | Sustainable Production Economics | 5 CR | Furmans, Lanza |

**Competence Certificate**
Written Exam (90 minutes)

**Prerequisites**
none

**Competence Goal**
After successful completion of the course, the students are able …

- to discuss, alone and in a team, the terms, contexts and models by which manufacturing companies are described;
- to discuss typical problems of manufacturing companies, especially against the background of current and future challenges of ecological, social and economic sustainability;
- to apply the most important methods for efficient and sustainable management in industrial enterprises, in particular in the sense of the circular economy, in a problem-related manner;
- to select and justify decision-making alternatives by applying the methods learned;
- to critically question the methods learned and to independently acquire methods that go beyond this.

**Content**
The module conveys an overall understanding of operational production management with special consideration of aspects of sustainability as well as an application-oriented understanding of the fundamental issues and methods in industrial companies. Through exercises as well as a business game synchronous to the lecture, the taught contents are deepened through application, so that the participants can apply them directly in their later professional environment.

**Annotation**
It is a joint module of the Institute of Materials Handling and Logistics (IFL) and the Institute of Production Science (WBK).

For the Bachelor's program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor's program Mechanical Engineering (International) a comparable module with comparable courses is offered in English.

**Workload**
Regluar attendance: 42 hours
Self-study: 108 hours

**Learning type**

1. Lectures (Obligatory)
2. Tutorials (Obligatory)

# M 7.34 Module: Technical Thermodynamics (BSc-Modul 05, TTD) [M-MACH-102574]

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

**Part of:** Fundamentals of Engineering

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---|---|---|---|---|---|---|
| 15 | Grade to a tenth | Each winter term | 2 terms | German/English | 3 | 2 |

| Mandatory | | | |
|---|---|---|---|
| T-MACH-104747 | Technical Thermodynamics and Heat Transfer I | 8 CR | Maas |
| T-MACH-105287 | Technical Thermodynamics and Heat Transfer II | 7 CR | Maas |
| T-MACH-105204 | Excercises in Technical Thermodynamics and Heat Transfer I<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Maas |
| T-MACH-105288 | Excercises in Technical Thermodynamics and Heat Transfer II<br>*This item will not influence the grade calculation of this parent.* | 0 CR | Maas |

**Competence Certificate**
See individual courses

**Prerequisites**
None

**Competence Goal**
The students acquire the competency to master the fundamentals of thermodynamics and the ability to apply this knowledge to problem-solving in various branches of mechanical engineering and especially in the energy technology sector.

An integral part of the module is that students can define the fundamental laws of thermodynamics and their applications. The students are competent in describing and comparing the main processes in energy conversion that are important in mechanical engineering. Using tools also applied in industry, they are capable of analyzing and rating the efficiency of processes. The students are capable of discussing the thermodynamic correlation of ideal gas mixtures, real gases, and humid air, as well as explaining the properties on a molecular basis and analyzing them with the help of the laws of thermodynamics. Furthermore, the students are capable of explaining chemical reactions in the context of thermodynamics as well as defining and applying the heat transfer mechanisms.

**Content**
Thermodynamics I:

- System, properties of state
- Absolute temperature, model systems
- 1st law of thermodynamics for resting and moving systems
- Entropy and 2nd law of thermodynamics
- Behavior of real substances described by tables, diagrams and equations of state
- Machine processes
- Mixtures of ideal and real compounds

Thermodynamics II:

- Repetition of the topics of "Thermodynamics and Heat Transfer I"
- Behavior of mixtures
- Moist air
- Kinetic theory of gases
- Behavior of real substances described by equations of state
- Chemical reactions and applications of the laws of thermodynamics to chemical reactions
- Reaction kinetics
- Heat Transfer

**Module grade calculation**
weight according to CP

**Annotation**
For the Bachelor’s program Mechanical Engineering the module (including all brick details, exams and courses) is offered in German.

For the Bachelor’s program Mechanical Engineering (International) the module (including all brick details, exams and courses) is offered in English.

**Workload**
lectures and exercises: 150h

homework and preparation of examination: 300h

**Learning type**
Lecture
Exercise course
Tutorial

# 8 Courses

## T 8.1 Course: Advanced Mathematics I [T-MATH-100275]

**Responsible:** PD Dr. Tilo Arens
Prof. Dr. Roland Griesmaier
PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MACH-104624 - Orientation Exam
M-MATH-102859 - Advanced Mathematics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 7 | Grade to a third | Each term | 3 |

| **Events** | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 0131000 | Höhere Mathematik I für die Fachrichtung Maschinenbau, Geodäsie, Materialwissenschaft und Werkstofftechnik | 4 SWS | Lecture | Hettlich |
| WT 24/25 | 0131200 | Höhere Mathematik I für die Fachrichtungen Chemieingenieurwesen, Verfahrenstechnik, Bioingenieurwesen und MIT | 4 SWS | Lecture | Hettlich |
| **Exams** | | | | | |
| ST 2024 | 6700025 | Advanced Mathematics I | | | Arens, Griesmaier, Hettlich |

**Competence Certificate**
Learning assessment is carried out by written examination of 120 minutes length.

**Prerequisites**
A "pass" result on the pre-requesite in AM I is a requirement for registration for the examination in AM I.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MATH-100525 - Tutorial Advanced Mathematics I must have been passed.

# T 8.2 Course: Advanced Mathematics II [T-MATH-100276]

**Responsible:** PD Dr. Tilo Arens
Prof. Dr. Roland Griesmaier
PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102859 - Advanced Mathematics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 7 | Grade to a third | Each term | 2 |

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 0180800 | Höhere Mathematik II für die Fachrichtungen Maschinenbau, Geodäsie, Materialwissenschaft und Werkstofftechnik | 4 SWS | Lecture | Arens |
| ST 2024 | 0181000 | Höhere Mathematik II für die Fachrichtungen Chemieingenieurwesen, Verfahrenstechnik, Bioingenieurwesen und MIT | 4 SWS | Lecture | Arens |
| **Exams** | | | | | |
| ST 2024 | 6700001 | Advanced Mathematics II | | | Arens, Griesmaier, Hettlich |

**Competence Certificate**
Learning assessment is carried out by written examination of 120 minutes length.

**Prerequisites**
A "pass" result on the pre-requesite in AM II is a requirement for registration for the examination in AM II.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MATH-100526 - Tutorial Advanced Mathematics II must have been passed.

# T 8.3 Course: Advanced Mathematics III [T-MATH-100277]

**Responsible:** PD Dr. Tilo Arens
Prof. Dr. Roland Griesmaier
PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102859 - Advanced Mathematics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 7 | Grade to a third | Each term | 2 |

| **Events** | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 0131400 | Höhere Mathematik III für die Fachrichtungen Maschinenbau, Chemieingenieurwesen, Verfahrenstechnik, Bioingenieurwesen und das Lehramt Maschinenbau | 4 SWS | Lecture | Griesmaier |
| **Exams** | | | | | |
| ST 2024 | 6700002 | Advanced Mathematics III | | | Arens, Griesmaier, Hettlich |

**Competence Certificate**
Learning assessment is carried out by written examination of 120 minutes length.

**Prerequisites**
A "pass" result on the pre-requesite in AM III is a requirement for registration for the examination in AM III.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MATH-100527 - Tutorial Advanced Mathematics III must have been passed.

# T 8.4 Course: Airport Logistics [T-MACH-105175]

**Responsible:** Dr.-Ing. André Richter
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102821 - Major Field: Technical Logistics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 3 | Grade to a third | Each winter term | 2 |

**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 8.5 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-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2133132 | Sustainable Vehicle Drivetrains | 2 SWS | Lecture / 🗣 | Toedter |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105655 | Sustainable Vehicle Drivetrains (Alternative Powertrain for Automobiles) | | | Toedter |

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

**Competence Certificate**
written exam

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

## V Sustainable Vehicle Drivetrains

2133132, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Sustainability
Environmental balance
Legislation
Alternative fuels
BEV
Fuel cell
Hybrid drives

# T 8.6 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-102645 - Major Field: Combustion Engine Techniques

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2134150 | Gas, lubricating oil and operating media analysis in drive train development | 2 SWS | Lecture / 🗣 | Gohl |

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

**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 Gas, lubricating oil and operating media analysis in drive train development

2134150, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V) On-Site**

**Literature**
Die Vorlesungsunterlagen werden vor jeder Veranstaltung an die Studenten verteilt.

# T 8.7 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-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design

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

**Competence Certificate**
oral exam (20 min)

**Prerequisites**
None

# T 8.8 Course: Atomistic Simulations and Particle Dynamics [T-MACH-113412]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2181740 | Particle Dynamics and Atomistic Simulations | 3 SWS | Lecture / Practice ( / 🗣 | Weygand, Gumbsch |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105308 | Atomistic Simulations and Particle Dynamics | | | Gumbsch, Weygand |
| ST 2024 | 76-T-MACH-105308-W | Atomistic Simulations and Particle Dynamics | | | Weygand, Gumbsch |

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

**Competence Certificate**
oral exam ca. 30 minutes

**Prerequisites**
none

**Recommendation**
preliminary knowlegde in mathematics, physics and materials science

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

## V Particle Dynamics and Atomistic Simulations

2181740, SS 2024, 3 SWS, Language: English, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

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

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

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

**Objective:** The student will be able to

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

Recommended Prerequisites: mathematics, physics, and materials science

Lecture: 22.5 hours

Exercises: 12 hours

Self-study: 85.5 hours

**Oral exam:** approximately 30 minutes

**Organizational issues**
Die Vorlesung wird auf Englisch angeboten!

**Literature**

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

# T 8.9 Course: Automated Manufacturing Systems [T-MACH-108844]

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

**Part of:** M-MACH-102589 - Major Field: Production Systems
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102820 - Major Field: Mechatronics
M-MACH-102821 - Major Field: Technical Logistics

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2150904 | Automated Manufacturing Systems | 6 SWS | Lecture / Practice ( / 🗣 | Fleischer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-108844 | Automated Manufacturing Systems | | | Fleischer |
| WT 24/25 | 76-T-MACH-108844 | Automated Manufacturing Systems | | | Fleischer |

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

**Competence Certificate**
oral exam (40 minutes)

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

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

## V Automated Manufacturing Systems

2150904, SS 2024, 6 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**
The lecture gives an overview of the structure and functioning of automated production plants. In a basic chapter, fundamental elements for the realisation of automated production systems are taught. These include:

- Drive and control technology
- Handling technology for handling workpieces and tools
- Industrial robot technology
- Quality assurance in automated production plants
- Automated machines, cells, centres and systems for production and assembly
- Structures of multi-machine systems
- Project planning of automated production plants

An interdisciplinary view of these sub-areas results in interfaces to Industry 4.0 approaches. The basic chapters are supplemented by practical application examples and live demonstrations in the Karlsruhe Forschungsfabrik.

In the second part of the lecture, the fundamentals taught will be clarified using practically executed production processes for manufacturing and disassembling components, and the automated production facilities for manufacturing these components will be analyzed. In the field of automotive powertrain technology, the automated production process for both the manufacture and disassembly of batteries is considered. In the powertrain area, automated production facilities for the disassembly of electric motors are considered. Furthermore, automated production systems for the field of additive manufacturing are considered.

Within tutorials, the contents from the lecture are deepened and applied to concrete 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

**Organizational issues**
Vorlesungstermine dienstags 8:00 Uhr und donnerstags 8:00 Uhr, Übungstermine donnerstags 09:45 Uhr.
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

**Literature**
**Medien:**
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.10 Course: Automotive Engineering I [T-MACH-100092]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113805 | Automotive Engineering I | 4 SWS | Lecture / 🗣 | Gießler |
| WT 24/25 | 2113809 | Automotive Engineering I | 4 SWS | Lecture / 🗣 | Gießler |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-100092 | Automotive Engineering | | | Gauterin, Gießler |
| WT 24/25 | 76-T-MACH-100092 | Automotive Engineering | | | Gießler |

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

**Competence Certificate**
Written examination

Duration: 120 minutes

Auxiliary means: none

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

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

## V Automotive Engineering I

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

**Lecture (V)**
**On-Site**

**Content**
1. History and future of the automobile

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

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

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

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

Learning Objectives:

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

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

Kann nicht mit der Veranstaltung [2113809] kombiniert werden.

Can not be combined with lecture [2113809].

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

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

3. Gauterin, F. / Unrau, H.-J. / Gnadler, R.: Scriptum zur Vorlesung "Grundlagen der Fahrzeugtechnik I", KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert

## V Automotive Engineering I

**Lecture (V)**
**On-Site**

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

**Content**
1. History and future of the automobile

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

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

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

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

Learning Objectives:

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

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

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

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

**Literature**
1. Robert Bosch GmbH: Automotive Handbook, 9th Edition, Wiley, Chichister 2015

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

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

4. Gauterin, F. / Gießler, M. / Gnadler, R.: Scriptum zur Vorlesung 'Automotive Engineering I', KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert

# T 8.11 Course: Automotive Engineering II [T-MACH-102117]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114835 | Automotive Engineering II | 2 SWS | Lecture / 🗣 | Gießler |
| ST 2024 | 2114855 | Automotive Engineering II | 2 SWS | Lecture / 🗣 | Gießler |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102117 | Automotive Engineering II | | | Gauterin, Gießler |
| ST 2024 | 76T-MACH-102117_mdl. | Automotive Engineering II | | | Gießler |
| WT 24/25 | 76-T-MACH-102117 | Automotive Engineering II | | | Gießler |
| WT 24/25 | 76T-MACH-102117-2 | Automotive Engineering II | | | Gießler |

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

**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 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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

Learning Objectives:

The students have an overview of the modules which are necessary for the tracking of a motor vehicle and the power transmission between vehicle bodywork and roadway. They have knowledge of different wheel suspensions, tyres, steering elements, and brakes. They know different design versions, functions and the influence on driving and braking behavior. They are able to correctly develop the appropriate components. They are ready to analyze, to evaluate, and to optimize the complex interaction of the different components under consideration of boundary conditions.

**Organizational issues**
Kann nicht mit der Veranstaltung [2114855] kombiniert werden.

Can not be combined with lecture [2114855]

**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.: Scriptum zur Vorlesung 'Grundlagen der Fahrzeugtechnik II', KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährliche Aktualisierung

## V Automotive Engineering II

**Lecture (V)**
**On-Site**

2114855, SS 2024, 2 SWS, Language: English, Open in study portal

**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

Learning Objectives:

The students have an overview of the modules which are necessary for the tracking of a motor vehicle and the power transmission between vehicle and roadway. They have knowledge of different wheel suspensions, tyres, steering elements, and brakes. They know different design versions, functions and the influence on driving and braking behavior. They are able to correctly develop the appropriate components. They are ready to analyze, to evaluate, and to optimize the complex interaction of the different components under consideration of boundary conditions.

**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 8.12 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-102638 - Major Field: Rail System Technology
M-MACH-102817 - Major Field: Information Technology
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102820 - Major Field: Mechatronics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 6 | Grade to a third | Each summer term | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2138340 | Automotive Vision | 3 SWS | Lecture / 🗣 | Lauer, Fehler |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105218 | Automotive Vision | | | Stiller, Lauer |

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

**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 2024, 3 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
**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

Nachweis: Written examination 60 minutes

Arbeitsaufwand (EN): 120 hours

**Literature**
Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.

# T 8.13 Course: Bachelor's Thesis [T-MACH-109188]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-104494 - Bachelor's Thesis

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Final Thesis | 12 | Grade to a third | Each term | 1 |

**Competence Certificate**
The bachelor 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 work load of the bachelor thesis corresponds to 12 ECTS. The maximal processing time of the bachelor thesis takes three months. 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 bachelor 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 bachelor thesis is not completed in time, this examination is "failed" (5,0), unless the student is not responsible.

The bachelor thesis is to be evaluated by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITG and another examiner. Generally, one of the two examiners is the person who has assigned the thesis. If the examiners do not agree, the bachelor thesis is graded by the examination board within this assessment; another expert can be appointed too. The bachelor thesis has to be graded within a period of six weeks after the submission.

**Prerequisites**
The requirement for admission to the bachelor thesis module are 120 ECTS. As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

**Modeled Conditions**
The following conditions have to be fulfilled:

1. You need to have earned at least 120 credits in the following fields:
   - Fundamentals of Engineering
   - Interdisciplinary Qualifications
   - Specialization in Mechanical Engineering

**Final Thesis**
This course represents a final thesis. The following periods have been supplied:

| | |
|---|---|
| **Submission deadline** | 3 months |
| **Maximum extension period** | 1 months |
| **Correction period** | 6 weeks |

**Annotation**
The workload for the preparation of the bachelor thesis is about 360 hours.

# T 8.14 Course: Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113579]

**Responsible:** Dr. Christine Mielke
Christine Myglas
**Organisation:**
**Part of:** M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

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

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

**Prerequisites**
None

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

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

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

**Annotation**

# T 8.15 Course: Basics in Measurement and Control Systems [T-MACH-104745]

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

**Part of:** M-MACH-102564 - Measurement and Control Systems

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 7 | Grade to a third | Each winter term | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2137301 | Measurement and Control Systems | 3 SWS | Lecture / 🗣 | Stiller |
| WT 24/25 | 2137302 | Measurement and Control Systems (Tutorial) | 1 SWS | Practice / 🗣 | Stiller, Rack |
| WT 24/25 | 3137020 | Measurement and Control Systems | 3 SWS | Lecture / 🗣 | Stiller |
| WT 24/25 | 3137021 | Measurement and Control Systems (Tutorial) | 1 SWS | Practice / 🗣 | Stiller |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-104745 | Basis of Measurement and Control Systems | | | Stiller |

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

**Competence Certificate**
written exam

2,5 hours

**Prerequisites**
none

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

## V Measurement and Control Systems

2137301, WS 24/25, 3 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
**Lehrinhalt (EN):**

1 Dynamic systems
2 Properties of important systems and modeling
3 Transfer characteristics and stability
4 Controller design
5 Fundamentals of measurement
6 Estimation
7 Sensors
8 Introduction to digital measurement

**Lernziele (EN):**

Measurement and control of physical entities is a vital requirement in most technical applications. Such entities may comprise e.g. pressure, temperature, flow, rotational speed, power, voltage and electrical current, etc.. From a general perspective, the objective of measurement is to obtain information about the state of a system while control aims to influence the state of a system in a desired manner. This lecture provides an introduction to this field and general systems theory. The control part of the lecture presents classical linear control theory. The measurement part discusses electrical measurement of non-electrical entities.

Voraussetzungen (EN)

Fundamentals in physics and electrical engineering; ordinary linear differential equations; Laplace transform

Nachweis (EN)

written exam; duration 2,5 h; paper reference materials only (no calculator)

Arbeitsaufwand (EN):

210 hours

**Literature**
Buch zur Vorlesung:
C. Stiller: Grundlagen der Mess- und Regelungstechnik, Shaker Verlag, Aachen, 2005

- Measurement and Control Systems:

R.H. Cannon: Dynamics of Physical Systems, McGraw-Hill Book Comp., New York, 1967
G.F. Franklin: Feedback Control of Dynamic Systems, Addison-Wesley Publishing Company, USA, 1988
R. Dorf and R. Bishop: Modern Control Systems, Addison-Wesley
C. Phillips and R. Harbor: Feedback Control Systems, Prentice-Hall

- Regelungstechnische Bücher:

J. Lunze: Regelungstechnik 1 & 2, Springer-Verlag
R. Unbehauen: Regelungstechnik 1 & 2, Vieweg-Verlag
O. Föllinger: Regelungstechnik, Hüthig-Verlag
W. Leonhard: Einführung in die Regelungstechnik, Teubner-Verlag
Schmidt, G.: Grundlagen der Regelungstechnik, Springer-Verlag, 2. Aufl., 1989

- Messtechnische Bücher:

E. Schrüfer: Elektrische Meßtechnik, Hanser-Verlag, München, 5. Aufl., 1992
U. Kiencke, H. Kronmüller, R. Eger: Meßtechnik, Springer-Verlag, 5. Aufl., 2001
H.-R. Tränkler: Taschenbuch der Messtechnik, Verlag Oldenbourg München, 1996
W. Pfeiffer: Elektrische Messtechnik, VDE Verlag Berlin 1999
Kronmüller, H.: Prinzipien der Prozeßmeßtechnik 2, Schnäcker-Verlag, Karlsruhe, 1. Aufl., 1980

**V** **Measurement and Control Systems** — **Lecture (V) On-Site**
3137020, WS 24/25, 3 SWS, Language: English, Open in study portal

**Content**
**Lehrinhalt (EN):**

1 Dynamic systems
2 Properties of important systems and modeling
3 Transfer characteristics and stability
4 Controller design
5 Fundamentals of measurement
6 Estimation
7 Sensors
8 Introduction to digital measuremen

**Lernhziele (EN):**

Measurement and control of physical entities is a vital requirement in most technical applications. Such entities may comprise e.g. pressure, temperature, flow, rotational speed, power, voltage and electrical current, etc.. From a general perspective, the objective of measurement is to obtain information about the state of a system while control aims to influence the state of a system in a desired manner. This lecture provides an introduction to this field and general systems theory. The control part of the lecture presents classical linear control theory. The measurement part discusses electrical measurement of non-electrical entities.

Nachweis (EN): written exam; duration 2,5 h; paper reference materials only (no calculator)

Arbeitsaufwand (EN): 180 hours

**Literature**

- Measurement and Control Systems:

R.H. Cannon: Dynamics of Physical Systems, McGraw-Hill Book Comp., New York,1967
G.F. Franklin: Feedback Control of Dynamic Systems, Addison-Wesley Publishing Company, USA, 1988
R. Dorf and R. Bishop: Modern Control Systems, Addison-Wesley
C. Phillips and R. Harbor: Feedback Control Systems, Prentice-Hall

- Regelungstechnische Bücher:

J. Lunze: Regelungstechnik 1 & 2, Springer-Verlag
R. Unbehauen: Regelungstechnik 1 & 2, Vieweg-Verlag
O. Föllinger: Regelungstechnik, Hüthig-Verlag
W. Leonhard: Einführung in die Regelungstechnik, Teubner-Verlag
Schmidt, G.: Grundlagen der Regelungstechnik, Springer-Verlag, 2. Aufl., 1989

- Messtechnische Bücher:

E. Schrüfer: Elektrische Meßtechnik, Hanser-Verlag, München, 5. Aufl., 1992
U. Kiencke, H. Kronmüller, R. Eger: Meßtechnik, Springer-Verlag, 5. Aufl., 2001
H.-R. Tränkler: Taschenbuch der Messtechnik, Verlag Oldenbourg München, 1996
W. Pfeiffer: Elektrische Messtechnik, VDE Verlag Berlin 1999
Kronmüller, H.: Prinzipien der Prozeßmeßtechnik 2, Schnäcker-Verlag, Karlsruhe, 1. Aufl., 1980

## V Measurement and Control Systems (Tutorial)

**Practice (Ü)**
**On-Site**

3137021, WS 24/25, 1 SWS, Language: English, Open in study portal

**Content**
Tutorial for Measurement and Control Systems

# T 8.16 Course: Basics of Manufacturing Technology [T-MACH-105219]

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

**Part of:** M-MACH-102549 - Manufacturing Processes

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2149658 | Basics of Manufacturing Technology | 2 SWS | Lecture / Practice ( / | Schulze |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105219 | Basics of Manufacturing Technology | | | Schulze |
| WT 24/25 | 76-T-MACH-105219 | Fundamentals of Manufacturing Technology | | | Schulze |

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

**Competence Certificate**
written exam (duration: 60 min)

**Prerequisites**
none

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

## V Basics of Manufacturing Technology

2149658, WS 24/25, 2 SWS, Language: German, Open in study portal

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

**Content**
The objective of the lecture is to classify the manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to establish basic process knowledge of the common processes. The lecture conveys the basic principles of manufacturing technology and deals with the manufacturing processes based on example components according to their classification into main groups regarding technical and economic aspects. Regard is paid to classic manufacturing processes as well as new developments like additive manufacturing processes.

The following topics will be covered:

- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment

**Learning Outcomes:**

The students ...

- are able to classify the manufacturing processes by their general functionality according to the specific main groups (DIN 8580).
- have the ability to declare and explain the function of the significant manufacturing processes of the main groups (DIN 8580).
- are enabled to describe the characteristic process features (geometry, materials, accuracy, tools, machines) of the significant manufacturing processes of the main groups (DIN 8580).
- have the ability to derive the relevant process specific technical advantages and disadvantages of the characteristic process features.
- are enabled to perform a selection of suitable manufacturing processes for given components.
- are enabled to classify the required manufacturing processes in the expiry of a process chain for the production of given sample products.

**Workload:**

regular attendance: 30 hours
self-study: 60 hours

**Literature**
**Medien:**
Skript zur Veranstaltung wird über ilias (https://ilias.studium.kit.edu/)
bereitgestellt.

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

# T 8.17 Course: Basics of Technical Logistics I [T-MACH-109919]

**Responsible:** Dr.-Ing. Martin Mittwollen
Dr.-Ing. Jan Oellerich

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102746 - Compulsory Elective Module

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2117095 | Basics of Technical Logistics I | 4 SWS | Lecture / Practice ( / 🗣 | Mittwollen |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-109919 | Basics of Technical Logistics I | | | Mittwollen |
| ST 2024 | 76-T-MACH-109919-mPr | Basics of Technical Logistics I | | | Mittwollen |

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

**Competence Certificate**
The assessment consists of a written exam (60 min.) according to § 4 paragraph 2 Nr. 1 of the examination regulation.

**Prerequisites**
none

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-112841 - Basics of Technical Logistics I must not have been started.

**Recommendation**
Knowledge of the basics of technical mechanics preconditioned.

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

## V Basics of Technical Logistics I

2117095, WS 24/25, 4 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**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

Students are able to:

- Describe processes and machines of technical logistics,
- Model the fundamental structures and the impacts of material handling machines with mathematical models,
- Refer to industrially used machines
- Model real machines applying knowledge from lessons and calculate their dimensions.

**Organizational issues**
Die Erfolgskontrolle erfolgt in Form einer schritflichen oder mündlichen Prüfung (nach §4 (2), 1 bzw. 2SPO).
The assessment consists of a written or oral exam according to Section 4 (2), 1 or 2of the examination regulation.
Es wird Kenntnis der Grundlagen der Technischen Mechanik vorausgesetzt.
Basics knowledge of technical mechanics is preconditioned.
Ergänzungsblätter, Präsentationen,Tafel.
Supplementary sheets, presentations, blackboard.
Präsenz: 48Std
Nacharbeit: 132Std
presence: 48h
rework: 132h

**Literature**
Empfehlungen in der Vorlesung / Recommendations during lessons

# T 8.18 Course: Basics of Technical Logistics I [T-MACH-112841]

**Responsible:** Dr.-Ing. Martin Mittwollen
Dr.-Ing. Jan Oellerich

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102821 - Major Field: Technical Logistics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2117095 | Basics of Technical Logistics I | 4 SWS | Lecture / Practice ( / | Mittwollen |

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

**Competence Certificate**
The assessment consists of an oral exam (duration approx. 20 minutes).

**Prerequisites**
none

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-109919 - Basics of Technical Logistics I must not have been started.

**Recommendation**
Knowledge of the basics of technical mechanics preconditioned.

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

## V Basics of Technical Logistics I

2117095, WS 24/25, 4 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**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

Students are able to:

- Describe processes and machines of technical logistics,
- Model the fundamental structures and the impacts of material handling machines with mathematical models,
- Refer to industrially used machines
- Model real machines applying knowledge from lessons and calculate their dimensions.

**Organizational issues**
Die Erfolgskontrolle erfolgt in Form einer schritflichen oder mündlichen Prüfung (nach §4 (2), 1 bzw. 2SPO).
The assessment consists of a written or oral exam according to Section 4 (2), 1 or 2of the examination regulation.
Es wird Kenntnis der Grundlagen der Technischen Mechanik vorausgesetzt.
Basics knowledge of technical mechanics is preconditioned.
Ergänzungsblätter, Präsentationen,Tafel.
Supplementary sheets, presentations, blackboard.
Präsenz: 48Std
Nacharbeit: 132Std
presence: 48h
rework: 132h

**Literature**
Empfehlungen in der Vorlesung / Recommendations during lessons

# T 8.19 Course: Basics of Technical Logistics II [T-MACH-109920]

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

**Part of:** M-MACH-102821 - Major Field: Technical Logistics

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2117098 | Basics of Technical Logistics II | 3 SWS | Lecture / Practice ( / 🗣 | Mittwollen |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-109920 | Basics of Technical Logistics II | | | Oellerich, Mittwollen |
| ST 2024 | 76-T-MACH-109920-mPr | Basics of Technical Logistics II | | | Mittwollen, Oellerich |

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

**Competence Certificate**
The assessment consists of a written exam (60 min.) according to § 4 paragraph 2 Nr. 1 of the examination regulation.

**Prerequisites**
none

**Recommendation**
Knowledge of the basics of technical mechanics and out of "Basic of Technical Logstics I" (T-MACH-109919) preconditioned.

# T 8.20 Course: Biomechanics: Design in Nature and Inspired by Nature [T-MACH-105651]

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

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 4 | pass/fail | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2181708 | Biomechanics: Design in Nature and Inspired by Nature | 3 SWS | / 🗣 | Mattheck |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105651 | Biomechanics: design in nature and inspired by nature | | | Mattheck |

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

**Competence Certificate**
Colloquium, ungraded.

**Annotation**
The number of participants is limited. Prior registration through ILIAS is necessary, In case of too many registrations, a selection (in accordance with SPO) will take place.

Before the registration in SP 26 (ME) or SP 01 (MSMT) the participation at the seminar must be confirmed.

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

## V Biomechanics: Design in Nature and Inspired by Nature

2181708, SS 2024, 3 SWS, Language: German, Open in study portal **On-Site**

**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

The students know and understand mechanical optimization schemes which are realized in nature. The students can analyze the derived thinking tools and can apply them for simple technical cases.

regular attendance: 30 hours
self-study: 90 hours

**Organizational issues**
Die Veranstaltung findet als Blockvorlesung von 09.07. bis 12.07.2024 statt.

# T 8.21 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-102645 - Major Field: Combustion Engine Techniques

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2134153 | Boosting of Combustion Engines | 2 SWS | / 🗣 | Kech |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105649 | Boosting of Combustion Engines | | | Koch |

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

**Competence Certificate**
oral exam, 20 min

**Prerequisites**
none

# T 8.22 Course: Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning [T-MACH-113359]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
**Part of:** M-MACH-102838 - Major Field: Energy Converting Engines

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (oral) | 4 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2169558 | Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning | 2 SWS | Lecture / 🗣 | Bauer |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-113359 | Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning | | | Bauer |

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

**Competence Certificate**
Oral exam, approximately 30 minutes

**Prerequisites**
Students successfully passed courses on fluid dynamics and thermodynamics.

**Recommendation**
- Profound knowledge on thermodynamics and fluid mechanics is mandatory.
- Machine and processes lecture (LVNr. 3134140) is highly recommended before taking this course.
- The course requires basic knowledge in engineering mathematics and computer programming at an undergraduate level. Basic knowledge in python is strongly recommended.
- We expect students to be interested in applying theoretical knowledge and translate it into real world experiments.

**Annotation**
Lectures: 90 min; Lab sessions: 90 minutes (6 weeks)

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

## V Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning

Lecture (V)
On-Site

2169558, WS 24/25, 2 SWS, Language: English, Open in study portal

**Content**
This lecture provides a comprehensive exploration of how small radial flow turbo machines contribute to the modern energy landscape. A typical application of such machines are pressurized fuel cells used as drive train for cars and trucks. From understanding the thermodynamics and flow characteristics of centrifugal compressors and centripetal turbines to practical experiments and the integration of machine learning techniques, students will gain a holistic understanding of the potential of turbo machines for energy conversion efficiency, emissions reduction, and performance optimization. The lecture further provides a hands on sample application of machine learning, with a specific focus on its pivotal role in developing digital twins that utilize sensory data.

During an integrated lab course, learned theoretical A.I. frameworks are applied to a turbo machine test rig for the accurate prediction of the operation and proactive prevention of surge and stall. By engaging in these experimental lab, students explore how sensory data can be leveraged to monitor and optimize the performance of centrifugal compressors. By combining theory and practical lab experience, this course equips students with the knowledge and skills necessary to leverage turbomachinery technology in shaping a sustainable and efficient future energy ecosystem.

The lecture features a distinctive structure consisting of three interconnected layers:

1. Fundamental Learning: This initial phase takes place in a traditional classroom setting where students establish a solid understanding of the subject matter.
2. Hands-On Practical Application: Students then transition to two dedicated laboratory sessions where they apply the acquired knowledge using real-life equipment, gaining valuable hands-on experience.
3. Data Analysis and Interpretation: Following the practical sessions, the lecture moves into two virtual laboratory sessions focused on data-driven techniques. Here, students analyze and interpret the data collected during the hands-on sessions, applying their newfound skills.

This unique approach endows the lecture with a marathon-like nature, requiring students to progress through these phases in sync with their peers. Collaboration is key, as lab sessions are conducted in groups, and students will consolidate and utilize data from all groups. Effective in-group and between-group communication becomes essential for the overall success of the learning experience.

The lecture duration is 21 hours, divided into theory and practical sessions.

pon completing this lecture, students will:

- Gain a comprehensive understanding of radial flow turbo machinery technology and its significance in the modern energy landscape.
- Learn the characteristics of centrifugal compressors and centripetal turbines and how they contribute to energy conversion efficiency, emissions reduction, and performance optimization.
- Engage in practical experiments to explore compressor characteristics, radial flow compressors and turbines, and surge and stall phenomena in radial compressors.
- Be introduced to machine learning principles and applications in turbomachinery technology.
- Gain hands-on experience in building digital twins from sensory data to monitor and optimize centrifugal compressor performance.
- Understand the importance of data-driven predictive maintenance and outlier detection in radial flow turbo machines.
- Learn how to use machine learning techniques to predict and prevent surge and stall issues in centrifugal compressor applications.
- Develop the knowledge and skills necessary to leverage turbomachinery technology in shaping a sustainable and efficient future energy ecosystem.

**Organizational issues**
Vorlesung ersetzt Vorlesung-Nr. 2169462 (Turbinen und Verdichterkonstruktionen) ab WS 2023/24

Number of participants are limited due to physical constraints of the integrated lab sessions. To enroll in the lecture, kindly complete the form below. Registration is open from **16.10.2023 (00:00:00)** to **23.10.2023 (23:59:00) (Note: The registration period will be extended until 25.10.2023 (23:59:00))**. Following the closure of the registration period, applicants will receive notifications regarding their selection, considering the limited number of available spots.

- Only master level students can be admitted to the course.
- Profound knowledge on thermodynamics and fluid mechanics is mandatory.
- Basic knowledge in python is strongly recommended.
- Machine and processes lecture is highly recommended before taking this course.
- We expect students to be interested in applying theoretical knowledge and translate it into real world experiments.
- Lecture is offered in English.

The lecture is part of the "Research Infrastructures in Research-Oriented Teaching (RIRO)" initative at KIT.

**Literature**
- Münzberg, H.G.: Gasturbinen - Betriebsverhalten und Optimierung, Springer Verlag, 1977.
- Traupel, W.: Thermische Turbomaschinen, Bd. I-II, Springer Verlag, 1977, 1982.
- Saravanamuttoo, H.I.H. et al: Gas Turbine Theory, 7th edition, Pearson, 2018.
- Brunton, S., Kutz, J. : Data-Driven Science and Engineering: Machine Learning, Dynamical Systems, and Control. Cambridge: Cambridge University Press. doi:10.1017/9781108380690
- gitlab.kit.edu/cihan.ates/data-driven-engineering

# T 8.23 Course: BUS-Controls - Advance [T-MACH-108889]

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

**Part of:** M-MACH-102820 - Major Field: Mechatronics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 0 | pass/fail | Each summer term | 1 |

**Competence Certificate**
Creation of control program

**Prerequisites**
none

# T 8.24 Course: CAD-NX Training Course [T-MACH-102187]

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

**Part of:** M-MACH-102583 - Major Field: Information Management

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (practical) | 2 | pass/fail | Each term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2123357 | CAD-NX training course | 2 SWS | Practical course / | Rönnau, Mitarbeiter |
| WT 24/25 | 2123357 | CAD-NX training course | 2 SWS | Practical course / | Rönnau, Mitarbeiter |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102187 | CAD-NX Training Course | | | Rönnau |

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

**Competence Certificate**
Practical verification as academic achievement by working on a design task on the 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 2024, 2 SWS, Language: German/English, Open in study portal

**Practical course (P)**
**Blended (On-Site/Online)**

**Content**

- 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

Students are able to:

- create their own 3D geometric models in the CAD system NX and generate drawings due to the created geometry
- carry out FE-studies and kinematic simulations using the integrated CAE tools
- use advanced, knowledge-based functionalities of NX to automate the creation of geometry and thus to ensure the reusability of the models.

**Organizational issues**
Informationen zum Ablauf des Praktikums werden in einer Auftaktveranstaltung veröffentlicht. Hinweise hierzu siehe ILIAS.

**Literature**
Praktikumsskript

## V CAD-NX training course

2123357, WS 24/25, 2 SWS, Language: German, Open in study portal

**Practical course (P)**
**Blended (On-Site/Online)**

**Content**

- 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

Students are able to:

- create their own 3D geometric models in the CAD system NX and generate drawings due to the created geometry
- carry out FE-studies and kinematic simulations using the integrated CAE tools
- use advanced, knowledge-based functionalities of NX to automate the creation of geometry and thus to ensure the reusability of the models.

**Organizational issues**
Das Praktikum kann entweder vorlesungsbegleitend oder als einwöchige Blockveranstaltung in der vorlesungsfreien Zeit absolviert werden. Weitere Informationen siehe ILIAS.

**Literature**
Praktikumsskript

# T 8.25 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-102583 - Major Field: Information Management
M-MACH-102746 - Compulsory Elective Module
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2147175 | CAE-Workshop | 3 SWS | Block / 🗣 | Düser |
| WT 24/25 | 2147175 | CAE-Workshop | 3 SWS | Block / 🗣 | Düser |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105212 | CAE-Workshop | | | Albers, Düser |

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

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

**Prerequisites**
None

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

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

## V CAE-Workshop

2147175, SS 2024, 3 SWS, Language: German, Open in study portal

**Block (B)**
**On-Site**

**Content**
Content:

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

The students are able to:

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

Exam: 1h Regularly written

Regular attendance: 31.5 h

Self-study: 88.5 h

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

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

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

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

V **CAE-Workshop** **Block (B)**
2147175, WS 24/25, 3 SWS, Language: German, Open in study portal **On-Site**

**Content**
Content:

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

The students are able to:

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

Regular attendance: 31.5 h

Self-study: 88.5 h

Exam: 1h written

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

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

**Literature**
Kursunterlagen werden in Ilias bereitgestellt.

Content is provided on Ilias.

# T 8.26 Course: CATIA CAD Training Course [T-MACH-102185]

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

**Part of:** M-MACH-102583 - Major Field: Information Management

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (practical) | 2 | pass/fail | Each term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2123358 | CATIA CAD training course | 2 SWS | Practical course / | Rönnau, Mitarbeiter |
| WT 24/25 | 2123358 | CATIA CAD training course | 2 SWS | Practical course / | Rönnau, Mitarbeiter |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102185 | CATIA CAD Training Course | | | Rönnau |

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

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

**Prerequisites**
None

**Recommendation**
Dealing with technical drawings is required.

**Annotation**
For the practical course attendance is compulsory.

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

## V CATIA CAD training course

2123358, SS 2024, 2 SWS, Language: German/English, Open in study portal

**Practical course (P)**
**Blended (On-Site/Online)**

**Content**

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

Students are able to:

- create their own 3D geometric models in the CAD system CATIA and generate drawings due to the created geometry
- carry out FE-studies and kinematic simulations using the integrated CAE tools
- use advanced, knowledge-based functionalities of CATIA to automate the creation of geometry and thus to ensure the reusability of the models.

**Organizational issues**
Informationen zum Ablauf des Praktikums werden in einer Auftaktveranstaltung veröffentlicht. Hinweise hierzu siehe ILIAS.

**Literature**
Praktikumskript

V

## CATIA CAD training course

2123358, WS 24/25, 2 SWS, Language: German, Open in study portal

**Practical course (P)**
**Blended (On-Site/Online)**

**Content**

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

Students are able to:

- create their own 3D geometric models in the CAD system CATIA and generate drawings due to the created geometry
- carry out FE-studies and kinematic simulations using the integrated CAE tools
- use advanced, knowledge-based functionalities of CATIA to automate the creation of geometry and thus to ensure the reusability of the models.

**Organizational issues**
Das Praktikum kann vorlesungsbegleitend absolviert werden oder als einwöchige Blockveranstaltung in der vorlesungsfreien Zeit. Weitere Informationen siehe ILIAS.

**Literature**
Praktikumskript

# T 8.27 Course: CO2-Neutral Combustion Engines and their Fuels I [T-MACH-111550]

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

**Part of:** M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2133113 | CO2-neutral combustion engines and their fuels I | 4 SWS | Lecture / Practice ( / | Koch |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102194 | CO2-neutral combustion engines and their fuels I | | | Koch, Kubach |

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

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

**Prerequisites**
none

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

## V CO2-neutral combustion engines and their fuels I

2133113, WS 24/25, 4 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

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

**Organizational issues**
Übungstermine Donnerstags nach Bekanntgabe in der Vorlesung

# T 8.28 Course: CO2-Neutral Combustion Engines and their Fuels II [T-MACH-111560]

**Responsible:** Prof. Dr. Thomas Koch
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2134151 | CO2-neutral combustion engines and their fuels II | 3 SWS | Lecture / Practice ( / 🗣 | Koch |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-104609 | Combustion Engines, Hydrogen Engines and CO2 neutral Fuels II | | | Koch, Kubach |

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

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

**Prerequisites**
none

**Recommendation**
Fundamentals of Combustion Engines II helpful

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

## V CO2-neutral combustion engines and their fuels II

2134151, SS 2024, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

# T 8.29 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-102821 - Major Field: Technical Logistics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 6 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2138341 | Cogitive Automobiles - Laboratory | 3 SWS | / 🗣 | Stiller, Lauer, Blumberg |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105378 | Cognitive Automobiles - Laboratory | | | Stiller |

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

**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 2024, 3 SWS, Language: German, Open in study portal **On-Site**

**Content**
**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.

**Nachweis:** Colloquia, final race

**Arbeitsaufwand**: 120 hours

**Literature**
Dokumentation zur SW und HW werden als pdf bereitgestellt.

# T 8.30 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-102812 - Major Field: Powertrain Systems
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2133113 | CO2-neutral combustion engines and their fuels I | 4 SWS | Lecture / Practice ( / 🗣 | Koch |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102194 | CO2-neutral combustion engines and their fuels I | | | Koch, Kubach |

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

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

**Prerequisites**
none

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

## V CO2-neutral combustion engines and their fuels I

2133113, WS 24/25, 4 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

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

**Organizational issues**
Übungstermine Donnerstags nach Bekanntgabe in der Vorlesung

# T 8.31 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:** Lightweight Design
M-MACH-102638 - Major Field: Rail System Technology
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114053 | Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies | 2 SWS | Lecture / | Henning |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105535 | Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies | | | Henning |
| WT 24/25 | 76-T-MACH-105535 | Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies | | | Henning |

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

**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

2114053, SS 2024, 2 SWS, Language: German, Open in study portal

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

**Content**
Physical connections of fiber reinforcement

Use and examples
- Automotive construction
- Transport
- Energy and construction
- Sport and recreation

Resins
- Thermoplastics
- Duromeres

Mechanisms of reinforcements
- Glas fibers
- Carbon fibers
- Aramid fibers
- Natural fibers

Semi-finished products - textiles

Process technologies - prepregs

Recycling of composites

**Aim of this lecture:**

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

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

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

**Organizational issues**
Die Lehrveranstaltung wird im SS 2024 als Hybridveranstaltung geplant.

**Literature**
**Literatur Leichtbau II**

[1-7]

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

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

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

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

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

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

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

# T 8.32 Course: Computational Dynamics [T-MACH-105349]

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

**Part of:** M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104442 - Major Field: Vibration Theory

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162246 | Computational Dynamics | 2 SWS | Lecture / 🗣 | Proppe |
| WT 24/25 | 2162246 | Computational Dynamics | 2 SWS | Lecture / 💻 | Proppe |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105349 | Computational Dynamics | | | Proppe |

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

**Competence Certificate**
oral exam, duration approx. 20 min.

**Prerequisites**
none

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

## V Computational Dynamics

2162246, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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

**Literature**
1. Ein Vorlesungsskript wird bereitgestellt!
2. M. Géradin, B. Rixen: Mechanical Vibrations, Wiley, Chichester, 1997

## V Computational Dynamics

2162246, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Online**

**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

**Literature**
1. Ein Vorlesungsskript wird bereitgestellt!
2. M. Géradin, B. Rixen: Mechanical Vibrations, Wiley, Chichester, 1997

# T 8.33 Course: Computational Intelligence [T-MACH-105314]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2105016 | Computational Intelligence | 2 SWS | Lecture / | Mikut, Reischl, Meisenbacher |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105314 | Computational Intelligence | | | Mikut |

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

**Competence Certificate**
Written exam (Duration: 1h)

**Prerequisites**
none

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

## V Computational Intelligence

2105016, WS 24/25, 2 SWS, Language: German, Open in study portal

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

**Content**
The students are able to apply the fundamental methods of computational intelligence (fuzzy logic, artificial neural networks, evolutionary algorithms, deep learning) 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
- Deep Learning: History, Architectures, Training strategies, Interpretability and Explainable AI, Use Cases

**Learning objectives:**

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

**Literature**

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

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

**Part of:** M-MACH-102638 - Major Field: Rail System Technology
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162256 | Computational Vehicle Dynamics | 2 SWS | Lecture / | Proppe |
| WT 24/25 | 2162256 | Computational Vehicle Dynamics | 2 SWS | Lecture / | Proppe |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105350 | Computational Vehicle Dynamics | | | Proppe |

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

**Competence Certificate**
oral exam, 30 min.

**Prerequisites**
none

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

## V Computational Vehicle Dynamics

2162256, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Online**

**Content**
This course serves as an introduction into the computational modelling and simulation of technical system road/ vehicle. A method based perspective is taken which allows for a unified treatment of various kinds of vehicles. The vehicle model is obtained by dividing the system into functional subsystems and defining interfaces between these subsystems.

In the first part of the course, vehicle models will be developed based on models of the suspensions, the road, and the contact forces between road and vehicle. The focus of the second part of the course is on computational methods for linear and non-linear models of vehicle systems. The third part of the course discusses design criteria for stability, safety and ride comfort. Multibody dynamics simulations will be carried out using Matlab/ Simulink.

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

**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

## V Computational Vehicle Dynamics

2162256, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Online**

**Content**
This course serves as an introduction into the computational modelling and simulation of technical system road/ vehicle. A method based perspective is taken which allows for a unified treatment of various kinds of vehicles. The vehicle model is obtained by dividing the system into functional subsystems and defining interfaces between these subsystems.

In the first part of the course, vehicle models will be developed based on models of the suspensions, the road, and the contact forces between road and vehicle. The focus of the second part of the course is on computational methods for linear and non-linear models of vehicle systems. The third part of the course discusses design criteria for stability, safety and ride comfort. Multibody dynamics simulations will be carried out using Matlab/ Simulink.

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

**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 8.35 Course: Computer Science for Engineers [T-MACH-105205]

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

**Part of:** M-MACH-102563 - Computer Science

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 6 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2121390 | Computer Science for Engineers | 4 SWS | Lecture / Practice ( | Elstermann, Meyer |
| ST 2024 | 3121034 | Computer Science for Engineers | 4 SWS | Lecture / Practice ( / 🗣 | Elstermann, Meyer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105205 | Computer Science for Engineers | | | Meyer, Elstermann |
| WT 24/25 | 76-T-MACH-105205 | Computer Science for Engineers - German | | | Meyer, Elstermann |

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

**Competence Certificate**
Written exam [180 min]

**Prerequisites**
Computer Science for Engineers, passed

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105206 - Computer Science for Engineers, Prerequisite must have been passed.

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

## V Computer Science for Engineers

2121390, SS 2024, 4 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**

**Content**
Basics: Information representation- and processing, terms and definitions: alphabet, data, signals, information, numeral systems, propositional logic and Boolean algebra, computer architectures, programming paradigms.

Object Orientation: Definition and important characteristics of object orientation, Object-oriented modeling with UML.

Data Structures: Definition, properties and application of graphs, trees, linked lists, queues and stacks.

Algorithms: Characteristics of algorithms, complexity analysis, design methods, important examples.

Database management systems: Relational data model, relational algebra, declarative language SQL.

**Organizational issues**
Keine Präsenzveranstaltung und keine wöchentlichen Vorlesungszeiten. Die Lehrinhalte des letzten Sommersemesters stehen in ILIAS zur Verfügung. Fehlende Vorleistungen für die Prüfung können in diesem Semester nochmals erbracht werden. Weiter Infos siehe ILIAS-Kurs zur Lehrveranstaltung.

**Literature**
Propädeutikum Java (2. Auflage), KIT Scientific Publishing; ISBN: 978 3 86644 914 5

„Grundkurs Programmieren in Java“ Carl Hanser Verlag GmbH & CO. KG; Auflage 6, ISBN 10: 3446426639

Robert Sedgewick : Algorithms in Java. Part 1-4. 3. Auflage. Addison Wesley, 2002, ISBN 0201361205

Robert Sedgewick : Algorithms in Java. Part 5. 3. Auflage. Addison Wesley, 2003, ISBN 0201361213

Peter Drake: Data Structures and Algorithms in Java 1. Auflage. Prentice Hall, 2005, ISBN 0131469142

Russ Miles, Kim Hamilton: Learning UML 2.0 , 1. Auflage, O'Reilly , 2006, ISBN 0596009828

Craig Larman : Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development , 3 Auflage. Prentice Hall, 2004, ISBN 0131489062

V

## Computer Science for Engineers

3121034, SS 2024, 4 SWS, Language: English, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**

Basics: Information representation- and processing, terms and definitions: alphabet, data, signals, information, numeral systems, propositional logic and Boolean algebra, computer architectures, programming paradigms.

Object Orientation: Definition and important characteristics of object orientation, Object-oriented modeling with UML.

Data Structures: Definition, properties and application of graphs, trees, linked lists, queues and stacks.

Algorithms: Characteristics of algorithms, complexity analysis, design methods, important examples.

Database management systems: Relational data model, relational algebra, declarative language SQL.

**Literature**

Robert Sedgewick : Algorithms in Java. Part 1-4. 3. Auflage. Addison Wesley, 2002, ISBN 0201361205

Robert Sedgewick : Algorithms in Java. Part 5. 3. Auflage. Addison Wesley, 2003, ISBN 0201361213

Peter Drake: Data Structures and Algorithms in Java 1. Auflage. Prentice Hall, 2005, ISBN 0131469142

Russ Miles, Kim Hamilton: Learning UML 2.0 , 1. Auflage, O'Reilly , 2006, ISBN 0596009828

Craig Larman : Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development , 3 Auflage. Prentice Hall, 2004, ISBN 0131489062

# T 8.36 Course: Computer Science for Engineers, Prerequisite [T-MACH-105206]

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

**Part of:** M-MACH-102563 - Computer Science

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (practical) | 0 | pass/fail | Each summer term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2121392 | Computer Lab for Computer Science in Mechanical Engineering | 2 SWS | / 🗣 | Elstermann, Meyer, Mitarbeiter |
| ST 2024 | 3121036 | Computer Science for Engineers Lab Course | 2 SWS | / 🖥 | Elstermann, Meyer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105206 | Computer Science for Engineers, Prerequisite | | | Meyer, Elstermann |

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

**Competence Certificate**
Programming assignments, that are to be implemented at the computer, are given every two weeks. The students are supervised by tutors while they work on the assignments. Therefore online tests must be solved by the students to assess the understanding of the tasks and the lecture material. All assignments have to be handed in, before they can take part in the exam.

**Prerequisites**
none

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

## V Computer Lab for Computer Science in Mechanical Engineering

2121392, SS 2024, 2 SWS, Language: German, Open in study portal **On-Site**

**Content**
JAVA programming assignments, that are to be implemented at the computer, are given every two weeks. The students are supervised by tutors while they work on the assignments. Therefore online tests must be solved by the students to assess the understanding of the tasks and the lecture material. All assignments have to be handed in, before they can take part in the exam.

**Organizational issues**
Wenn Poolräume nutzbar, dann Poolräume

**Literature**
Übungsblätter / exercise sheets

## V Computer Science for Engineers Lab Course

3121036, SS 2024, 2 SWS, Language: English, Open in study portal **Online**

**Content**
JAVA programming assignments, that are to be implemented at the computer, are given every two weeks. The students are supervised by tutors while they work on the assignments. Therefore online tests must be solved by the students to assess the understanding of the tasks and the lecture material. All assignments have to be handed in, before they can take part in the exam.

**Organizational issues**
Wenn Präsenz möglich, dann ID-Raum Nutzung

**Literature**
Exercise sheets / Übungsblätter

# T 8.37 Course: Constitution and Properties of Wearresistant Materials [T-MACH-102141]

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

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2194643 | Constitution and Properties of Wear resistant materials | 2 SWS | Lecture / 🗣 | Ulrich |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102141 | Constitution and Properties of Wearresistant Materials | | | Ulrich |

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

**Competence Certificate**
oral examination (about 30 min)

no tools or reference materials

**Prerequisites**
none

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

## V Constitution and Properties of Wear resistant materials

2194643, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

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

Teaching Content:

introduction

materials and wear

unalloyed and alloyed tool steels

high speed steels

stellites and hard alloys

hard materials

hard metals

ceramic tool materials

superhard materials

new developments

regular attendance: 22 hours
self-study: 98 hours

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

Recommendations: none

**Organizational issues**
Die Blockveranstaltung findet in folgendem Zeitraum statt:

15.04.-17.04.2024: jeweils von 8:00-16:00 Uhr;

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

Anmeldung verbindlich bis zum 13.04.2024 unter sven.ulrich@kit.edu.

Nach der Anmeldung wird Ihnen im Falle einer Online-Veranstaltung der Link zur Vorlesung per E-Mail am 14.04.2024 mitgeteilt.

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

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

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

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

# T 8.38 Course: Continuum Mechanics of Solids and Fluids [T-MACH-110377]

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

**Part of:** M-MACH-102582 - Major Field: Continuum Mechanics
M-MACH-102746 - Compulsory Elective Module

| Type | Credits | Grading scale | Recurrence | Expansion | Version |
|---|---|---|---|---|---|
| Written examination | 3 | Grade to a third | Each winter term | 1 terms | 5 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2161252 | Continuum mechanics of solids and fluids | 2 SWS | Lecture / 🗣 | Böhlke, Frohnapfel |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-110377 | Continuum Mechanics of Solids and Fluids | | | Böhlke, Frohnapfel |

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

**Competence Certificate**
Written examination (90 min). Additives as announced

**Prerequisites**
Coursework in *Tutorial Continuum Mechanics of Solids and Fluids* (T-MACH-110333) must be passed

**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.

**Annotation**
Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) and students of the bachelor's degree program in material science and material technology will be admitted to the computer tutorials in any case.
If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

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

## V Continuum mechanics of solids and fluids

2161252, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- 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

**Literature**
Vorlesungsskript

Greve, R.: Kontinuumsmechanik, Springer 2003

Liu, I-S.: Continuum Mechanics. Springer, 2002

Schade, H.: Strömungslehre, de Gruyter 2013

# T 8.39 Course: Control of Mobile Machines [T-MACH-111821]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics

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

| Exams | | | |
|---|---|---|---|
| ST 2024 | 76-T-MACH-111821 | Control of mobile machines | Becker, 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**
A prerequisite for participation in the examination is the preparation of a semester report. The preexamination with the code T-MACH-111820 must be passed.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-111820 - Control of Mobile Machines – Prerequisites must have been passed.

# T 8.40 Course: Control of Mobile Machines – Prerequisites [T-MACH-111820]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 0 | pass/fail | Each summer term | 1 |

| Exams | | | |
|---|---|---|---|
| ST 2024 | 76-T-MACH-111820 | Control of mobile machines - Advance | Becker, Geimer |

**Competence Certificate**
Preparation of a report on the completion of the semester task

**Prerequisites**
none

# T 8.41 Course: Control Technology [T-MACH-105185]

**Responsible:** Hon.-Prof. Dr. Christoph Gönnheimer
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102817 - Major Field: Information Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2150683 | Control Technology | 2 SWS | Lecture / 🗣 | Gönnheimer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105185 | Control Technology | | | Gönnheimer |
| WT 24/25 | 76-T-MACH-105185 | Control Technology | | | Gönnheimer |

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

**Competence Certificate**
Written Exam (60 min)

**Prerequisites**
none

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

## V Control Technology

2150683, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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

**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

**Organizational issues**
Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

**Literature**
**Medien**:
Skript zur Veranstaltung wird über ilias (https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.42 Course: Data Analytics for Engineers [T-MACH-105694]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2106014 | Data Analytics for Engineers | 3 SWS | Lecture / Practice ( / ) | Mikut, Reischl, Meisenbacher |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105694 | Datenanalyse für Ingenieure | | | Mikut, Reischl |

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

**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 2024, 3 SWS, Language: German, Open in study portal

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

**Content**
**Content:**

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

**Learning objectives:**

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

**Literature**
Vorlesungsunterlagen (ILIAS)

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

2008 (PDF frei im Internet)

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

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

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

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

# T 8.43 Course: Data-Driven Algorithms in Vehicle Technology [T-MACH-112126]

**Responsible:** Dr. Stefan Scheubner
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113840 | Data-Driven Algorithms in Vehicle Technology | 2 SWS | Lecture / | Scheubner |
| **Exams** | | | | | |
| ST 2024 | 7600001 | Data-Driven Algorithms in Vehicle Technology | | | Scheubner |
| WT 24/25 | 7600001 | Data-Driven Algorithms in Vehicle Technology | | | Scheubner |

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

**Competence Certificate**
Written Examination

Duration: 90 minutes

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

## V Data-Driven Algorithms in Vehicle Technology

2113840, WS 24/25, 2 SWS, Language: English, Open in study portal

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

**Content**
Course Syllabus: Data-Driven Algorithms in Vehicle Technology
Motivation for the Course: Nowadays, engineers often develop technical systems using a combination of hard- and software. This is true especially for modern passenger vehicle development. In a digitalized world, such developments are built on knowledge gained from relevant data sources, e.g. the vehicle sensors. Therefore, engineers in automobile technology need qualifications from data science to successfully create new functionalities in the cars. To prevent remaining purely theoretical, the algorithms in this course are explained using a real-world problem of “EV Routing”. Students have the opportunity to test methods in Python with frequent exercises presented.
Goal of the Course: Students have a basic understanding of data-driven algorithms such as Markov Models, Machine Learning or Monte-Carlo Methods. The approach for building data-driven models in automobile technology are known to students and they are able to test algorithms in the programming language “Python”. Furthermore, students have learnt how to analyse the algorithm performance.
Content:
1. Introduction to function development as well as the prerequisites for the course (e.g. Fundamentals for running Python code)
2. Fundamentals for EV Routing and relevant data sources
3. Parameter estimation and state classification algorithms to determine the current situation of the vehicle
4. Learning methods for driver behaviour
5. Forecast algorithms to predict future energy consumption of an electric vehicle

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

Die erste VL am 22.10.24 um 14:00 Uhr findet in Präsenz am Campus Ost, Geb. 70.04, Raum 219 statt.

Alle weiteren Vorlesungsinhalte werden als Videoaufzeichnungen in ILIAS bereit gestellt. In regelmäßigen Abständen wird es Sprechstunden geben. Die genauen Termine erfahren Sie dann über den entsprechenden ILIAS Kurs

# T 8.44 Course: Decision-Making and Motion Planning for Automated Driving [T-MACH-113597]

**Responsible:** Dr.-Ing. Maximilian Naumann
apl. Prof. Dr. Moritz Werling

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102817 - Major Field: Information Technology
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102820 - Major Field: Mechatronics
M-MACH-102821 - Major Field: Technical Logistics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 6 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2137401 | Decision-Making and Motion Planning for Automated Driving | 3 SWS | Lecture / | Naumann, Werling |

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

**Competence Certificate**
written examination, duration 60 min.

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

**Prerequisites**
none

**Annotation**
Basic knowledge of control engineering and systems theory should be available from "Measurement and Control Systems" or from other lectures.

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

## V Decision-Making and Motion Planning for Automated Driving

2137401, WS 24/25, 3 SWS, Language: English, Open in study portal

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

**Content**
**Kurzfassung (EN):**
Driver assistance is on its way to evolve from pure driving dynamics control systems, such as ABS or ESP, to full automation. To realize new, customer-value safety and comfort systems, the primary task of active driving interventions in steering, accelerator and braking is shifting from the so-called vehicle stabilization level to the so-called vehicle guidance level, the new subject area of modern assistance systems. The challenge here is to provide optimum support for the driver without patronizing him. The next step is driving automation, in which the driving task is completely taken over, at least in certain situations. For highly and fully automated vehicles, the challenge is to produce pleasant, safe and predictable driving behavior under given uncertainties in the perception of the environment and the behavior of other road users.

**Lernziele (EN):**

The lecture is aimed at students of mechanical engineering and related courses who wish to acquire interdisciplinary qualifications in a future-oriented subject area. It covers control engineering, information technology and vehicle technology aspects and provides a holistic overview of the field of automated vehicle control. Practical application examples from innovative driver assistance and driving automation systems deepen and illustrate the lecture content.

**Contents:**

*Part 1:* Driver Assistance:
1) Introduction to driver assistance
2) System description and modeling
3) Assistance systems of the stabilization level
4) Assistance systems of the command level

*Part 2:* Driving Automation:
5) Introduction Maneuver Planning
6) Dynamic Programming
7) Linear-quadratic optimization problems
8) Model predictive control
9) Decision making under uncertainty (MDPs, reinforcement learning, imitation learning).

**Prerequisites:**
Basic knowledge of control engineering and systems theory should be available from "Measurement and Control Systems" or from lectures of other departments.

Nachweis: written exam

Arbeitsaufwand: 180 hours

**Organizational issues**
Die Vorlesung ist die Nachfolgevorlesung von LV 2138336 Verhaltensgenerierung für Fahrzeuge.

# T 8.45 Course: Design and Development of Mobile Machines [T-MACH-105311]

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

**Part of:** M-MACH-102815 - Major Field: Engineering Design

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113079 | Design and Development of Mobile Machines | 2 SWS | Lecture / 🗣 | Geimer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105311 | Design and Development of Mobile Machines | | | Geimer |
| WT 24/25 | 76-T-MACH-105311 | Design and Development of Mobile Machines | | | Geimer |

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

**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

2113079, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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 electric drive train,
- the dimensioning of the primary energy supply,
- 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.

**Recommendations:**

Knowledge in Fluid Technology (SoSe, LV 21093)

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

**Literature**
Keine.

# T 8.46 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-102815 - Major Field: Engineering Design

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 0 | pass/fail | Each term | 1 |

| Exams | | | |
|---|---|---|---|
| WT 24/25 | 76-T-MACH-108887 | Design and Development of Mobile Machines - Advance | Geimer |

**Competence Certificate**
Preparation of semester report

**Prerequisites**
none

# T 8.47 Course: Design and Optimization of Conventional and Electrified Automotive Transmissions [T-MACH-110958]

**Responsible:** Prof. Dr.-Ing. Albert Albers
Dr.-Ing. Hartmut Faust

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2146208 | Design and Optimization of Conventional and Electrified Automotive Transmissions | 2 SWS | Lecture / 🗣 | Faust |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105536 | Design and Optimization of Conventional and Electrified Automotive Transmissions | | | Faust, Albers |

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

**Competence Certificate**
oral exam (20 min)

**Prerequisites**
none

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

## V Design and Optimization of Conventional and Electrified Automotive Transmissions

**Lecture (V) On-Site**

2146208, SS 2024, 2 SWS, Language: German, Open in study portal

**Content**

- Transmission types: Manual (MT) & automated manual transmissions (AMT), planetary torque converter machines (AT), double clutch (DCT), continuously variable (CVT) and geared neutral transmissions (IVT), hybrid transmissions (serial, parallel, multimode, Powersplit hybrid), E-axles
- Torsional vibration damper: damped clutch disc, dual mass flywheel, centrifugal pendulum (FKP), lock-up damper for torque converter
- Starting elements: dry single clutch, dry and wet double clutch, hydrodynamic torque converter, special shapes, e-motor
- Power transmission: countershaft transmission, planetary gear set, CVT variator, chain, synchronization, shift and claw clutches, reversing, differentials and locking systems, coaxial and axially parallel E-axis drives
- Transmission control: shift systems for MT, actuators for clutches and gear shifting, hydraulic control, electronic control, software application, comfort and sportiness
- Special designs: drive trains of commercial vehicles, hydrostat with power split, torque vectoring
- E-mobility: Classification into 5 stages of electrification, 4 hybrid configurations, 7 parallel hybrid architectures, hybridized transmissions (P2, P2.5, P3, P4), dedicated hybrid transmissions (DHT; serial / parallel / multimode, powersplit, new ones Concepts), gearbox for electric vehicles (E-axle gearbox, coaxial and axially parallel)

**Organizational issues**
**Die Vorlesung wird als Blockvorlesung, in voraussichtlich etwa 14-tägigen Rhythmus gehalten. Genaue Termine und weitere Infos:** http://www.ipek.kit.edu/70_2819.php

**Lernziele**

Die Studenten erwerben das Wissen aus aktuellen Getriebe-, Hybrid- und reinen Elektroantriebs-Entwicklungen über …

- die Funktionsweise und Auslegung von konventionellen und elektrifizierten Fahrzeuggetrieben und deren Komponenten;
- Konstruktions- und Funktionsprinzipien der wichtigsten Komponenten von Handschalt-, Doppelkupplungs-, stufenlosen und Planetenautomat-Getrieben;
- komfortrelevante Zusammenhänge und Abhilfemaßnahmen;
- die Hybridisierung und Elektrifizierung der Triebstränge auf Basis bekannter Getriebetypen und mit speziellen sogenannten Dedicated Hybrid Transmissions (DHT) sowie Bewertung der Konzepte auf Systemebene.

# T 8.48 Course: Design of a Jet Engine Combustion Chamber [T-CIWVT-105780]

**Responsible:** Dr.-Ing. Stefan Raphael Harth
**Organisation:** KIT Department of Chemical and Process Engineering
**Part of:** M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2232310 | Design of a Jet Engine Combustion Chamber | 2 SWS | / | Harth |

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

**Competence Certificate**
The examination is an oral examination on lecture 22527 with a duration of 20 minutes.

**Prerequisites**
None

# T 8.49 Course: Design with Plastics [T-MACH-105330]

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

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102819 - Major Field: Materials Science and Engineering

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

**Competence Certificate**
Oral exam, about 20 minutes

**Prerequisites**
none

**Recommendation**
Poly I

# T 8.50 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-102815 - Major Field: Engineering Design

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2161229 | Designing with numerical methods in product development | 2 SWS | Lecture / 🗣 | Schnack |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-108719 | Designing with numerical methods in product development | | | |

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

**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

2161229, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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.

**Literature**
Vorlesungsskript

# T 8.51 Course: Development Methods of Technical Systems [T-MACH-111283]

**Responsible:** Dipl.-Ing. Thomas Maier
Prof. Dr.-Ing. Jivka Ovtcharova

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102583 - Major Field: Information Management

| Type | Credits | Grading scale | Recurrence | Expansion | Version |
|---|---|---|---|---|---|
| Examination of another type | 4 | Grade to a third | Each term | 1 terms | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2121002 | Development methods of technical systems | 4 SWS | Project (P / 🗣 | Meyer |
| WT 24/25 | 2121002 | Development methods of technical systems | 4 SWS | Project (P / 🗣 | Meyer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-111283 | Development Methods of Technical Systems | | | Meyer |

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

**Competence Certificate**
Graded examination of other type weighted 50% project documentation and 50% colloquium.

**Prerequisites**
None

**Recommendation**
None

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

## V Development methods of technical systems

2121002, SS 2024, 4 SWS, Language: German/English, Open in study portal

**Project (PRO)**
**On-Site**

**Content**
Requirements, SysML, Modelica, FEM high performance computing, process modeling, VR/AR

Students can exemplarily:

- Collect requirements for large technical systems (e.b.: Helmholtz large-scale device KATRIN).
- Describe physical systems across domains with the modeling language Modelica and simulate the systems behavior.
- Generate simple FE meshes for simulations of structural mechanics.
- Perform general FEM analyses on mainframe computers and prepare and explain simulation results.
- As a team present the learned skills and document them continuously.

## V Development methods of technical systems

2121002, WS 24/25, 4 SWS, Language: German/English, Open in study portal

**Project (PRO)**
**On-Site**

**Content**
Requirements, SysML, Modelica, FEM high performance computing, process modeling, VR/AR

Students can exemplarily:

- Collect requirements for large technical systems (e.b.: Helmholtz large-scale device KATRIN).
- Describe physical systems across domains with the modeling language Modelica and simulate the systems behavior.
- Generate simple FE meshes for simulations of structural mechanics.
- Perform general FEM analyses on mainframe computers and prepare and explain simulation results.
- As a team present the learned skills and document them continuously.

**Organizational issues**
Zeit und Ort siehe ILIAS

# T 8.52 Course: Development of Hybrid Drivetrains [T-MACH-110817]

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

**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2134155 | Development of Hybrid Powertrains | 2 SWS | Lecture / 🗣 | Koch, Doppelbauer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-110817 | Development of hybrid drivetrains | | | Koch |

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

**Competence Certificate**
written exam, 1 hour

**Prerequisites**
None

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

## V Development of Hybrid Powertrains

2134155, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

1. Introduction and Goal
2. Alternative Powertrains
3. Fundamentals of Hybrid Powertrains
4. Fundamentals of Electric Components of Hybrid Powertrains
5. Interactions in Hybrid Powertrain Development
6. Overall System Optimization

# T 8.53 Course: Development of Oil-Hydraulic Powertrain Systems [T-MACH-105441]

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

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113072 | Development of Oil-Hydraulic Powertrain Systems | 2 SWS | Block / 🗣 | Geerling |

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

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

**Block (B)**
**On-Site**

**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

knowledge in the fluidics

- regular attendance: 19 hours
- self-study: 90 hours

**Organizational issues**
siehe Homepage

# T 8.54 Course: Digital Control [T-MACH-105317]

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

**Part of:** M-MACH-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2137309 | Digital Control | 2 SWS | Lecture / 🗣 | Knoop, Rack |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105317 | Digital Control | | | Stiller |

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

**Competence Certificate**
written exam

60 min.

**Prerequisites**
none

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

## V Digital Control

2137309, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
**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.

Nachweis: oral examination; duration: 30 minutes

Arbeitsaufwand: 120 hours

**Literature**


- Lunze, J.: Regelungstechnik 2, 9. Auflage, Springer Verlag, Berlin Heidelberg 2016.
- 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 8.55 Course: Digitization in the Railway System [T-MACH-113016]

**Responsible:** Prof. Dr.-Ing. Martin Cichon
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-102638 - Major Field: Rail System Technology

| Type | Credits | Grading scale | Recurrence | Expansion | Version |
|---|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each winter term | 1 terms | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2115920 | Railway System Digitalisation | 2 SWS | Lecture / 🗣 | Jost, Cichon |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-106426 | Railway System Digitalisation | | | Jost |

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

**Competence Certificate**
Oral examination
Duration: approx. 20 minutes
No tools or reference material may be used during the exam.

# T 8.56 Course: Dimensioning of Additive-Manufactured Polymer Structures at an Example from Medical Engineering [T-MACH-112717]

**Responsible:** Prof. Dr.-Ing. Luise Kärger
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-102746 - Compulsory Elective Module
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102820 - Major Field: Mechatronics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Examination of another type | 4 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114102 | Dimensioning of additive-manufactured polymer structures at an example from medical engineering | 3 SWS | Lecture / Practice ( / | Kärger |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-112717 | Dimensioning of additive-manufactured polymer structures at an example from medical engineering | | | Kärger |

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

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

## V Dimensioning of additive-manufactured polymer structures at an example from medical engineering

2114102, SS 2024, 3 SWS, Language: German, Open in study portal

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

**Content**
Additive manufacturing (AM) processes, also known as "3D printing", allow the economical production of individualised components with a high degree of design freedom. This makes them particularly important in industries with very low quantities and many prototype tests, such as medical engineering. In orthopaedics, for example, it is often helpful to adapt splints or orthoses to the patient's individual anatomy and functional requirements. Due to their good processability, adjustable properties and low density, polymer-based materials are increasingly applied. However, the goal-oriented development of such customised polymer components requires knowledge of the according processes and materials and can be effectively supported by computer-aided CAE methods.

In the course, students learn about additive manufacturing (AM) of individualised polymer components and apply their competences in a development project during the semester. The course first provides an overview of established AM process technologies and uses the example of extrusion processes to work out the interaction of material, process settings and design. Special requirements of medical technology for component development and material selection are presented in separate lectures. This is followed by an application-oriented introduction to the practical component design of printed polymer structures using the finite element method (FEM). FE-based topology optimisation is presented as a particularly suitable tool to devise efficient mechanical structures. The CAE design methods are specifically deepened in practice in exercises. With this knowledge of processes, materials and methods, the students finally solve an individual development project from the field of orthotics in small groups.

**Main topics:**

- Overview of additive manufacturing processes
- Process-material-component interaction
- Polymers in additive manufacturing:

Fundamentals of polymer science, material and component testing,

- Special aspects of additive manufacturing in medical technology (external guest contributions):

Selection of process and material, orthotics/prosthetics as an application case

- Computer-aided component design and optimisation
- (lectures and exercises)
- Semester project:
  Design, manufacture and testing of an AM component from the field of "medical technology

**Learning objectives**
The students can...

- ... name and describe different AM manufacturing technologies for polymer components and select them based on their characteristics (especially advantages/disadvantages and process limits).
- ... describe the development chain in additive manufacturing

(material selection, CAD, simulation/optimisation, slicer software) and implement it.

- ... describe the interaction of process parameters, material properties and design for polymer components at the example of extrusion processes.
- ... name and explain relevant additional medical technology aspects, e.g. sterilisability or allergy potential, in material and process selection
- ... explain essential concepts of the finite element method and topology optimisation
- ... use the finite element software "Abaqus" for component design and evaluate simulation results with regard to informative value and load-bearing capacity
- ... carry out a topology optimisation with the software Tosca, interpret its results and derive structural concepts.
- ... successfully realise an individual development project in the area of additive manufacturing in a goal-oriented manner.

**Organizational issues**
Die Raumbelegung und der wöchentliche Veranstaltungstermin wird zu Beginn des Sommersemesters auf der Homepage des Instituts bekannt gegeben.

Aufgrund des gewünschten Betreuungsverhältnisses und der Institutsausstattung ist die maximale Anzahl der teilnehmenden Studierenden begrenzt. Die Anmeldung erfolgt über die Instituts-Homepage ab Anfang März.

Zusätzliche Übungen werden an weiteren fünf Terminen immer von **15:45 – 17:15 in R. 125**, Geb. 70.04, Campus Ost stattfinden: 29.05., 06.06, 20.06, 27.06., 04.07.24.

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The room allocation and the weekly course dates are announced on the Institute's homepage at the beginning of the summer semester.

Due to the desired supervision ratio and the institute's equipment, the maximum number of participating students is limited.

Registration takes place via the Institute's homepage from the beginning of March.

Additional exercises will take place on 5 dates from 15:45 - 17:15 in room 125 at Building 70.04, Campus East: 29.05., 06.06, 20.06., 27.06., 04.07.24.

# T 8.57 Course: Drive System Engineering A: Automotive Systems [T-MACH-113405]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

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

**Competence Certificate**
written examination: 90 min duration

**Prerequisites**
None

# T 8.58 Course: Drive Train of Mobile Machines [T-MACH-105307]

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

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113077 | Drive Train of Mobile Machines | 2 SWS | Lecture / 🗣 | Geimer |
| WT 24/25 | 2113078 | Übung zu 'Antriebsstrang mobiler Arbeitsmaschinen' | 1 SWS | Practice / 🗣 | Geimer, Bargen-Herzog |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105307 | Drive Train of Mobile Machines | | | Geimer |
| WT 24/25 | 76-T-MACH-105307 | Drive Train of Mobile Machines | | | Geimer |

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

**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) On-Site**
2113077, WS 24/25, 2 SWS, Language: German, Open in study portal

**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

**Recommendations:**

- general basics of mechanical engineering
- basic knowledge in hydraulics
- interest in mobile machines

- regular attendance: 21 hours
- self-study: 89 hours

**Literature**
Skriptum zur Vorlesung downloadbar über ILIAS

# T 8.59 Course: Dynamic Systems of Technical Logistics [T-MACH-112113]

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

**Part of:** M-MACH-102821 - Major Field: Technical Logistics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 6 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2148605 | Dynamic Systems of Technical Logistics | 4 SWS | Lecture / Practice ( / 🗣 | Mittwollen |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-112113 | Dynamic Systems of Technical Logistics | | | Mittwollen |

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

**Competence Certificate**
The assessment consists of an oral exam (approx. 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 -I** (LV 2117095) preconditioned.

Knowledge out of **Basics of Technical Logistics-II** (LV 2117098) recommended.

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

## V Dynamic Systems of Technical Logistics

2148605, SS 2024, 4 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**
Conveyor technology = motion = dynamics

Insight into the structure, mode of operation, dynamics and safety of materials handling equipment along the process chain of technical logistics from raw material extraction through processing, distribution, storage and order picking to shipping.
Bulk material mining, transport, handling, storage
Stability and tipping safety when turning, slewing, driving cranes
Overhead cranes - structure, dynamics, safety
Conveyors in material handling systems (belt, chain, AGV, EMS, ...)
Elevators - structure, dynamics, safety
Material flow systems - structure, basic elements, information flow
Storage and racking systems - structure, dynamics, order picking
Storage and retrieval systems - structure, dynamics, safety

**Organizational issues**
DSTL und DSTL-P sind zeitlich so gegliedert, dass zunächst unter Hinzunahme des Donnerstags-Zeitslots für das Projekt ausschließlich der Vorlesungs- und Übungsteil bis ca. Ende Juni gehalten wird. Der anschließende Zeitraum ist ausschließlich für die (optionale) Projektarbeit vorgesehen.

# T 8.60 Course: Dynamic Systems of Technical Logistics - Project [T-MACH-112114]

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

**Part of:** M-MACH-102821 - Major Field: Technical Logistics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Examination of another type | 4 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2148606 | Dynamic Systems of Technical Logistics - Project | 2 SWS | Project (P / 🗣 | Mittwollen |

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

**Competence Certificate**
Presentation of performed project and defense (30min) according to $4 (2), No. 3 of the examination regulation

**Prerequisites**
T-MACH-112113 (Dynamic Systems of Technical Logistics) must have been started.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-112113 - Dynamic Systems of Technical Logistics must have been started.

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

## V Dynamic Systems of Technical Logistics - Project

2148606, SS 2024, 2 SWS, Language: German, Open in study portal

**Project (PRO)**
**On-Site**

**Content**
Conveyor technology = motion = dynamics
Course content:
The knowledge acquired in the lecture DSTL will be extended and deepened together with the previous knowledge from GTL I/II in the context of an independent project work based on an application case from the current research and project work at IFL. Analyses, research, design work, calculations and simulations are used.

**Organizational issues**
DSTL und DSTL-P sind zeitlich so gegliedert, dass zunächst unter Hinzunahme des Mittwochs-Zeitslots für die Vorlesung ausschließlich der Vorlesungs- und Übungsteil bis ca. Ende Juni gehalten wird. Der anschließende Zeitraum ist ausschließlich für die (optionale) Projektarbeit vorgesehen.

# T 8.61 Course: Dynamics of Electro-Mechanical Systems [T-MACH-111260]

**Responsible:** Philipp Altoé
Prof. Dr.-Ing. Alexander Fidlin

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104442 - Major Field: Vibration Theory

| Type | Credits | Grading scale | Expansion | Version |
|---|---|---|---|---|
| Written examination | 5 | Grade to a third | 1 terms | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162210 | Dynamics of electro-mechanical systems | 2 SWS | Lecture / ✕ | Fidlin |
| ST 2024 | 2162211 | Dynamics of electro-mechanical systems (Tutorial) | 2 SWS | Practice / ✕ | Fidlin, Altoé |

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

**Competence Certificate**
Written exam, 180 minutes

**Prerequisites**
None

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

## V Dynamics of electro-mechanical systems

2162210, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Cancelled**

**Content**
The lecture conveys two kinds of describing electro-mechanical systems. The first one (described shortly) is based on state and flow variables, the second one (which is in the focus of the course) is based on an energetic description and the Lagrange-Maxwell-Formalism. These methods are then applied in order to analyse the most important electro-mechanical systems. These include

- Dynamics of electro-mechanical converter and vibration exciters taking into account the load in resonance operation
- Dynamics of electrical machines taking into account the rotordynamic effects (imbalance, loss of stability, passage through resonance)
- Dynamics of piezo-electrical converters in sensor and actor operation

**Organizational issues**
Die Vorlesung Dynamik elektromechanischer Systeme wird im Sommersemester 2024 nicht angeboten.

# T 8.62 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-102812 - Major Field: Powertrain Systems
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104442 - Major Field: Vibration Theory

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 5 | Grade to a third | Each winter term | 2 |

| Exams | | | |
|---|---|---|---|
| ST 2024 | 76-T-MACH-105226 | Dynamics of the Automotive Drive Train | Fidlin |

**Competence Certificate**
Oral examination, 30 min.

**Prerequisites**
none

**Recommendation**
Powertrain Systems Technology A: Automotive SystemsMachine DynamicsVibration Theory

# T 8.63 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration [T-FORUM-113580]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**

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

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

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

**Prerequisites**
None

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

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

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

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

# T 8.64 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration [T-FORUM-113582]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**

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

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

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

**Prerequisites**
None

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

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

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

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

# T 8.65 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration [T-FORUM-113581]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**

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

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

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

**Prerequisites**
None

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

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

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

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

# T 8.66 Course: Electrical Engineering and Electronics [T-ETIT-109820]

**Responsible:** Prof. Dr. Martin Doppelbauer
**Organisation:** KIT Department of Electrical Engineering and Information Technology
**Part of:** M-ETIT-104801 - Electrical Engineering

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2306339 | Electrical Engineering and Electronics foir Mechanical Engineers | 4 SWS | Lecture / ✕ | Brodatzki |
| WT 24/25 | 2306340 | Electrical Engineering and Electronics foir Mechanical Engineers | 2 SWS | Practice / ✕ | Digel, Bremer |
| **Exams** | | | | | |
| ST 2024 | 7306351 | Electrical Engineering and Electronics for Mechanical Engineers | | | Brodatzki |
| WT 24/25 | 7306351 | Electrical Engineering and Electronics for Mechanical Engineers | | | Doppelbauer |

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

**Annotation**
Exam will be held in german language

# T 8.67 Course: Energy Efficient Intralogistic Systems [T-MACH-105151]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102821 - Major Field: Technical Logistics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2117500 | Energy efficient intralogistic systems | 2 SWS | Lecture / 🗣 | Kramer, Schönung |

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

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

**Prerequisites**
none

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

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

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

## V Energy efficient intralogistic systems

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

**Lecture (V)**
**On-Site**

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

**Organizational issues**
Blockveranstaltung 2022/2023. Die Veranstaltung findet in Präsenz statt

**Literature**
Keine.

# T 8.68 Course: Energy Systems I: Renewable Energy [T-MACH-105408]

**Responsible:** apl. Prof. Dr. Ron Dagan
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2129901 | Energy Systems I - Renewable Energy | 2 SWS | Lecture / 🗣 | Dagan |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105408 | Energy Systems I: Renewable Energy | | | Dagan |
| WT 24/25 | 76-T-MACH-105408 | Energy Systems I: Renewable Energy | | | Dagan |

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

**Competence Certificate**
oral exam, approx. 1/2 hour

**Prerequisites**
none

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

## V Energy Systems I - Renewable Energy

2129901, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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.

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

# T 8.69 Course: Engine Laboratory [T-MACH-105337]

**Responsible:** Dr.-Ing. Uwe Wagner
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques
M-MACH-102838 - Major Field: Energy Converting Engines

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 4 | pass/fail | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2134001 | Engine Laboratory | 2 SWS | Practical course / 🗣 | Wagner |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105337 | Engine Laboratory | | | Koch |

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

**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 2024, 2 SWS, Language: German, Open in study portal

**Practical course (P)**
**On-Site**

**Organizational issues**
voraussichtlich 1. vorlesungsfreie Woche im SS 2021. Wird auf der Homepage und in den Vorlesungen bekannt gegeben

**Literature**
Versuchsbeschreibungen

# T 8.70 Course: Engine Measurement Techniques [T-MACH-105169]

**Responsible:** Dr.-Ing. Sören Bernhardt
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques
M-MACH-102817 - Major Field: Information Technology
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2134137 | Engine measurement techniques | 2 SWS | Lecture / 🗣 | Bernhardt |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105169 | Engine Measurement Techniques | | | Koch |

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

**Competence Certificate**
oral examination, Duration: 0,5 hours, no auxiliary means

**Prerequisites**
none

**Recommendation**
T-MACH-102194 Combustion Engines I

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

## V Engine measurement techniques

2134137, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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 8.71 Course: Engineering Mechanics I [T-MACH-100282]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102572 - Engineering Mechanics
M-MACH-104624 - Orientation Exam

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 7 | Grade to a third | Each winter term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2161245 | Engineering Mechanics I | 3 SWS | Lecture / 🗣 | Böhlke |
| WT 24/25 | 3161010 | Engineering Mechanics I (Lecture) | 3 SWS | Lecture / 🗣 | Langhoff, Böhlke |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-100282 | Engineering Mechanics I | | | Böhlke, Langhoff |
| ST 2024 | 76-T-MACH-100282-englisch | Engineering Mechanics I | | | Böhlke, Langhoff |

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

**Competence Certificate**
written exam, 90 min, graded

**Prerequisites**
successful participation in "Engineering Mechanics I (Tutorial)" (see T-MACH-100528)

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-100528 - Tutorial Engineering Mechanics I must have been passed.

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

## V Engineering Mechanics I

2161245, WS 24/25, 3 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- Basics of vector calculus
- Force systems
- Statics of rigid bodies
- Internal forces and moments in bars and beams
- Friction
- Centre of gravity, centre of mass
- Work, energy, principle of virtual work
- Statics of inextensible ropes
- Elastostatics of tension-compression- bars

**Literature**

- Vorlesungsskript
- Hibbeler, R.C: Technische Mechanik 1 - Statik. Prentice Hall. Pearson Studium 2005
- Gross, D. et al.: Technische Mechanik 1 - Statik. Springer 2006
- Gummert, P.; Reckling, K.-A.: Mechanik. Vieweg 1994
- Parkus, H.: Mechanik der festen Körper. Springer 1988

# T 8.72 Course: Engineering Mechanics II [T-MACH-100283]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102572 - Engineering Mechanics
M-MACH-104624 - Orientation Exam

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162250 | Engineering Mechanics II | 3 SWS | Lecture / 🗣 | Böhlke, Langhoff |
| ST 2024 | 3162010 | Engineering Mechanics II (Lecture) | 3 SWS | Lecture / 🗣 | Langhoff, Böhlke |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-100283 | Engineering Mechanics II | | | Böhlke, Langhoff |
| ST 2024 | 76-T-MACH-100283-englisch | Engineering Mechanics II | | | Böhlke, Langhoff |

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

**Competence Certificate**
written exam, 90 min, graded

**Prerequisites**
successful participation in "Engineering Mechanics II (Tutorial)" (see T-MACH-100284)

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-100284 - Tutorial Engineering Mechanics II must have been passed.

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

## V Engineering Mechanics II

2162250, SS 2024, 3 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- bending
- shear
- torsion
- stress and strain state in 3D
- Hooke's law in 3D
- elasticity theors in 3D
- energy methods in elastostatics
- approximation methods
- stability of elastic bars

**Literature**
Vorlesungsskript
Hibbeler, R.C: Technische Mechanik 2 - Festigkeitslehre. Prentice Hall. Pearson Studium 2005.
Gross, D. et al.: Technische Mechanik 2 - Elastostatik. Springer 2006.
Gummert, P.; Reckling, K.-A.: Mechanik. Vieweg 1994.
Parkus, H.: Mechanik der festen Körper. Springer 1988.

## V Engineering Mechanics II (Lecture)

3162010, SS 2024, 3 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- bending
- shear
- torsion
- stress and strain state in 3D
- Hooke's law in 3D
- elasticity theors in 3D
- energy methods in elastostatics
- approximation methods
- stability of elastic bars

# T 8.73 Course: Engineering Mechanics III & IV [T-MACH-105201]

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

**Part of:** M-MACH-102572 - Engineering Mechanics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 10 | Grade to a third | Each winter term | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162231 | Engineering Mechanics IV | 2 SWS | Lecture / 🗣 | Proppe |
| ST 2024 | 3162012 | Engineering Mechanics 4 | 2 SWS | Lecture / 🖳 | Römer |
| WT 24/25 | 2161203 | Engineering Mechanics III | 2 SWS | Lecture / 🗣 | Proppe |
| WT 24/25 | 3161012 | Engineering Mechanics III (Lecture) | 2 SWS | Lecture / 🗣 | Fidlin |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105201 | Engineering Mechanics III & IV | | | Fidlin, Proppe |

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

**Competence Certificate**
Written Exam (3 h), graded

**Prerequisites**
Succesful accomplishment of the exercise sheets in Engineering Mechanics III (T-MACH-105202) and of the exercise sheets in Engineering Mechanics IV (T-MACH-105203).

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105202 - Tutorial Engineering Mechanics III must have been passed.
2. The course T-MACH-105203 - Tutorial Engineering Mechanics IV must have been passed.

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

## V Engineering Mechanics IV

2162231, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Spatial kinematics of a rigid body, Euler angles, angular velocity using Euler angles, Euler's equations, inertia tensor, kinetic energy of a rigid body, free gyroscopes, forced gyroscopes, systems of rigid bodies, principle of d'Alembert, Lagrange's equations of the first and second kind, generalized coordinates, free and forced vibration of one degree of freedom systems, frequency response, vibration of multi degree of freedom systems, vibration absorption

**Organizational issues**
Hinweis: Die Lehrveranstaltung TM4 (MACH SPO: 2015, MIT SPO: 2016) wird letztmalig im Sommersemester 2024 angeboten. Die Lehrinhalte werden zu einem großen Teil ab Wintersemester 24/25 im Rahmen der TM3 (MACH und MIT: SPO 2023) behandelt. Die Vorleistung für Studierende in den alten SPOs (MACH SPO: 2015, MIT SPO: 2016) werden weiterhin in einer angepassten Form angeboten, die zu gegebener Zeit über ILIAS kommuniziert wird.

**Literature**
Hibbeler: Technische Mechanik 3, Dynamik, München, 2006
Marguerre: Technische Mechanik III, Heidelberger Taschenbücher, 1968
Magnus: Kreisel, Theorie und Anwendung, Springer-Verlag, Berlin,
1971 Klotter: Technische Schwingungslehre, 1. Bd. Teil A, Heidelberg

## V Engineering Mechanics 4

3162012, SS 2024, 2 SWS, Language: English, Open in study portal

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

**Content**
The students know some possibilities to describe the position and orientation of a rigid body for an abitrary 3d motion. They realize that the rotational velocity is a vector which may change both magnitude and orientation. They can apply the principle of linear momentum and the principle of moment of momentum to a spatial motion of a rigid boy and notice that this is much more complicated compared to a plain motion. The students can caculate the coordinates of the intertia tensor. They see that many effects which may be seen with gyroscopes can be explained by the principle of moment of momentum. For systems with many particles or bodies but only few degrees of freedom the students know that the application of analytical methods like the principle of D'Alembert in Lagrangian form or the Lagrange equations may be advantageous. They can apply these principles to simple problems. For vibration problems the students can interprete the most important expressions like eigenfrequency, resonance or eigenvalue problem. Forced vibration of systems with the degree of freedom can be investigated by the students.

## V Engineering Mechanics III

2161203, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Kinematics: Cartesian, cylindrical and natural coordinates. Time derivatives in moving reference frames, angular velocities of reference frames.

Kinetics of a particle:
Newton's axiom, Principle of d'Alembert, work of a force, kinetic and potential energies, principle of linear momentum, principle of moment of momentum, kinetics in moving reference systems

Systems of particles:
Principle of center of mass, Principle of moment of momentum, impacts between particles, systems with variable mass, applications.

Plain motion of rigid bodies:
Pure translation, pure rotation, general plain motion. Instantaneous center of rotation, Kinetics, moment of momentum, principle of work and principle of energy conservation for a rotation around a space-fixed axis. Mass moment of inertia, parallel-axis-theorem.Principle of linear momentum and principle of moment of momentum for arbitrary plain motion. Principle of d'Alembert for plain motion. Principles of linear and moment of momentum in integral form. Applications for impact problems.

**Organizational issues**
Die Lehrveranstaltung TM III (MACH SPO: 2015, MIT SPO: 2016) wird letztmalig im Wintersemester 2023/24 angeboten. Die Lehrinhalte werden zu einem großen Teil ab Wintersemester 2024/25 im Rahmen der TM III (MACH und MIT: SPO 2023) behandelt. Die Vorleistung für Studierende in den alten SPOs (MACH SPO: 2015, MIT SPO: 2016) werden weiterhin in einer angepassten Form angeboten, die zu gegebener Zeit über ILIAS kommuniziert wird.

**Literature**
Hibbeler: Technische Mechanik 3, Dynamik, München, 2006

Gross, Hauger, Schnell: Technische Mechanik Bd. 3, Heidelberg, 1983

Lehmann: Elemente der Mechanik III, Kinetik, Braunschweig, 1975

Göldner, Holzweissig: Leitfaden der Technischen Mechanik.

Hagedorn: Technische Mechanik III.

## V Engineering Mechanics III (Lecture)

3161012, WS 24/25, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Kinematics: Cartesian, cylindrical and natural coordinates. Time derivatives in moving reference frames, angular velocities of reference frames.

Kinetics of a particle: Newton's axiom, principle of d'Alembert, work of force, kinetic and potential energies, principle of linear momentum, principle of moment of momentum, kinetics in moving reference systems

Systems of particles: principle of center of mass, principle of moment of momentum, impacts between particles, systems with variable mass, applications

Plain motion of rigid bodies: pure translation, pure rotation, general plain motion. Instantaneous center of rotation , kinetics, moment of momentum, principle of work and princicple of energy conservation for a rotation around a space-fixed axis. Mass moment of inertia, parallel-axis-theorem. Principle of linear momentum and principle of moment of momentum for arbitrary plain motion. Principle of d'Alembert for plain motion. Principles of linear and moment of momentum in integral form. Applications for impact problems.

# T 8.74 Course: Excercises in Technical Thermodynamics and Heat Transfer I [T-MACH-105204]

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

**Part of:** M-MACH-102574 - Technical Thermodynamics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (written) | 0 | pass/fail | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2165502 | Exercise course Technical Thermodynamics and Heat Transfer I | 2 SWS | Practice / 🗣 | Maas |
| WT 24/25 | 2165503 | Tutorial Technical Thermodynamics and Heat Transfer I | 2 SWS | Tutorial ( / 🗣 | Maas |
| WT 24/25 | 3165015 | Technical Thermodynamics and Heat Transfer I (Tutorial) | 2 SWS | Tutorial ( / 🗣 | Schießl, Maas |
| WT 24/25 | 3165018 | Technical Thermodynamics and Heat Transfer I (Auditorium exercises) | 2 SWS | Practice / 🗣 | Schießl, Maas |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105204 | Excercises in Technical Thermodynamics and Heat Transfer I | | | Maas, Schießl |
| WT 24/25 | 76-T-MACH-105204 | Excercises in Technical Thermodynamics and Heat Transfer I | | | Maas, Schießl |

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

**Competence Certificate**
Successful completion of written preliminary tests.

**Prerequisites**
none

# T 8.75 Course: Excercises in Technical Thermodynamics and Heat Transfer II [T-MACH-105288]

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

**Part of:** M-MACH-102574 - Technical Thermodynamics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 0 | pass/fail | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2166556 | Technical Thermodynamics and Heat Transfer II (Tutorial) | 2 SWS | Practice / 🗣 | Maas |
| ST 2024 | 3166033 | Technical Thermodynamics and Heat Transfer II (Tutorial) | 2 SWS | Practice / 🗣 | Schießl, Maas |
| WT 24/25 | 2100020 | Technical Thermodynamics and Heat Transfer II (Repeater Tutorial) | 2 SWS | Tutorial ( / 🗣 | Schießl |
| WT 24/25 | 2165530 | Technical Thermodynamics and Heat Transfer II (Repeater Tutorial) | 2 SWS | Practice / 🗣 | Maas |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105288 | Excercises in Technical Thermodynamics and Heat Transfer II | | | Maas, Schießl |
| WT 24/25 | 76-T-MACH-105288 | Excercises in Technical Thermodynamics and Heat Transfer II | | | Maas, Schießl |

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

**Competence Certificate**
Successful completion of written preliminary tests.

**Prerequisites**
none

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

## V Technical Thermodynamics and Heat Transfer II (Tutorial)

2166556, SS 2024, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Calculation of thermodynamical problems

**Literature**
Vorlesungsskriptum
Elsner, N.; Dittmann, A.: Energielehre und Stoffverhalten (Grundlagen der technischen Thermodynamik Bd. 1 und 2), 8. Aufl., Akademie-Verlag, 680 S. 1993.
Baehr, H.D.: Thermodynamik: eine Einführung in die Grundlagen und ihre technischen Anwendungen, 9. Aufl., Springer-Verlag, 460 S., 1996.

## V Technical Thermodynamics and Heat Transfer II (Repeater Tutorial)

2165530, WS 24/25, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Literature**
Vorlesungsskriptum
Elsner, N.; Dittmann, A.: Energielehre und Stoffverhalten (Grundlagen der technischen Thermodynamik Bd. 1 und 2), 8. Aufl., Akademie-Verlag, 680 S. 1993.
Baehr, H.D.: Thermodynamik: eine Einführung in die Grundlagen und ihre technischen Anwendungen, 9. Aufl., Springer-Verlag, 460 S., 1996.

# T 8.76 Course: Exercices - Tribology [T-MACH-109303]

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

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2181114 | Tribology | 5 SWS | Lecture / Practice ( / | Dienwiebel, Scherge |

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

**Competence Certificate**
successful solving of all exercises

**Prerequisites**
none

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

## V Tribology

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

**Lecture / Practice (VÜ)**
**On-Site**

**Content**

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, evironmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems
- evaluate the friction and wear behavior of tribological systems
- explain the effects of lubricants and their most important additives
- identify suitable approaches to optimize tribological systems
- explain the most important experimental methods for the measurement of friction and wear, and is able to use them for the characterisation of tribo pairs
- choose suitable methods for the evaluation of roughness and topography from the nm-scale to the mm-scale and is able to interpret the determined values in respect to their effect on the tribological behavior
- describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces

preliminary knowlegde in mathematics, mechanics and materials science recommended

regular attendance: 45 hours
self-study: 195 hours

oral examination (ca. 40 min)

no tools or reference materials

admission to the exam only with successful completion of the exercises

**Literature**

1. Fleischer, G. ; Gröger, H. ; Thum: Verschleiß und Zuverlässigkeit. 1. Auflage. Berlin : VEB-Verlag Technik, 1980
2. Persson, B.J.N.: Sliding Friction, Springer Verlag Berlin, 1998
3. M. Dienwiebel, and M. Scherge, Nanotribology in automotive industry, In:Fundamentals of Friction and Wear on the Nanoscale; Editors: E. Meyer and E. Gnecco, Springer, Berlin, 2007.
4. Scherge, M., Shakhvorostov, D., Pöhlmann, K.: Fundamental wear mechanism of metals. Wear 255, 395–400 (2003)
5. Shakhvorostov, D., Pöhlmann, K., Scherge, M.: An energetic approach to friction, wear and temperature. Wear 257, 124–130 (2004)

# T 8.77 Course: Exercises for Materials Characterization [T-MACH-107685]

**Responsible:** Dr.-Ing. Jens Gibmeier
Prof. Dr. Reinhard Schneider
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2174586 | Materials Characterization | 2 SWS | Lecture / 🗣 | Gibmeier, Peterlechner |
| ST 2024 | 2174988 | Tutorials and lab courses for "materials characterization" | 1 SWS | Practice / 🗣 | Gibmeier, Peterlechner |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-107685 | Exercises for Materials Characterization | | | Gibmeier |

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

**Competence Certificate**
Regular attendance

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

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

## V Materials Characterization

2174586, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

**learning objectives:**
The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure**.**

**Literature**
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

## V Tutorials and lab courses for "materials characterization"

2174988, SS 2024, 1 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

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

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

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

**Literature**
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

# T 8.78 Course: Experimental Dynamics [T-MACH-105514]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102820 - Major Field: Mechatronics
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104442 - Major Field: Vibration Theory

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162225 | Experimental Dynamics | 3 SWS | Lecture / ✕ | Fidlin |
| ST 2024 | 2162228 | Übungen zu Experimentelle Dynamik | 2 SWS | Practice / ✕ | Fidlin, Genda |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105514 | Experimental Dynamics | | | Fidlin |

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

**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 2024, 3 SWS, Language: German, Open in study portal

**Lecture (V)**
**Cancelled**

**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

**Organizational issues**
Die Vorlesung Experimentelle Dynamik wird im Sommersemester 2024 nicht angeboten.

# T 8.79 Course: Failure Analysis [T-MACH-105724]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2182572 | Failure Analysis | 2 SWS | Lecture / 🗣 | Greiner, Schneider |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105724 | Failure Analysis | | | Schneider |
| WT 24/25 | 76-T-MACH-105724 | Failure Analysis | | | Schneider, Greiner |

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

**Competence Certificate**
oral examination, ca. 30 min

**Prerequisites**
none

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

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

## V Failure Analysis

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

**Lecture (V)**
**On-Site**

**Content**
Aim, procedure and content of examining failure
Examination methods
Types of failure:
Failure due to mechanical loads
Failure due to corrosion in electrolytes
Failure due to thermal loads
Failure due to tribological loads
Damage systematics

The students are able to discuss damage evaluation and to perform damage investigations. They know the common necessary investigation
methods and can regard failures considering load and material resistance. Furthermore they can describe and discuss the most important types of failure and damage appearance.

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

regular attendance: 21 hours
self-study: 99 hours

oral exam, duration: ca. 30 minutes
no notes

**Literature**


1. G. Lange: Systematische Beurteilung technischer Schadensfälle, 6. Auflage, WILEY-VCH Verlag, 2014, ISBN 978-3-527-68316-1, In der KIT-BIB online verfügbar!
2. A. Neidel, et al.: Handbuch Metallschäden -- REM-Atlas und Fallbeispiele zur Ursachenanalyse und Vermeidung, 2. Auflage, Hanser Verlag, 2011, ISBN 978-3-446-42966-6
3. J. Grosch, et al.: Schadenskunde im Maschinenbau: Charakteristische Schadensursachen – Analyse und Aussagen von Schadensfällen, 6. Auflage, Expert-Verlag, 2014, ISBN 978-3-816-93172-0
4. E. Wendler-Kalsch, H. Gräfen: Korrosionsschadenkunde, Springer-Verlag, 1998, ISBN 3-540-63377-4

# T 8.80 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-102812 - Major Field: Powertrain Systems
M-MACH-102819 - Major Field: Materials Science and Engineering

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2181711 | Failure of structural materials: deformation and fracture | 3 SWS | Lecture / Practice ( / 🗣 | Gumbsch, Weygand |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102140 | Failure of Structural Materials: Deformation and Fracture | | | Weygand, Gumbsch |
| WT 24/25 | 76-T-MACH-102140 | Failure of Structural Materials: Deformation and Fracture | | | Weygand, Gumbsch, Kraft |

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

**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

2181711, WS 24/25, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**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

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.

**Organizational issues**
Übungstermine werden in der Vorlesung bekannt gegeben!

**Literature**

- Engineering Materials, M. Ashby and D.R. Jones (2nd Edition, Butterworth-Heinemann, Oxford, 1998); sehr lesenswert, relativ einfach aber dennoch umfassend, verständlich
- Mechanical Behavior of Materials, Thomas H. Courtney (2nd Edition, McGraw Hill, Singapur); Klassiker zu den mechanischen Eigenschaften der Werkstoffe, umfangreich, gut
- Bruchvorgänge in metallischen Werkstoffen, D. Aurich (Werkstofftechnische Verlagsgesellschaft Karlsruhe), relativ einfach aber dennoch umfassender Überblick für metallische Werkstoffe

# T 8.81 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-102819 - Major Field: Materials Science and Engineering

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2181715 | Failure of Structural Materials: Fatigue and Creep | 2 SWS | Lecture / 🗣 | Gruber, Gumbsch |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102139 | Failure of Structural Materials: Fatigue and Creep | | | Gruber, Gumbsch |
| WT 24/25 | 76-T-MACH-102139 | Failure of Structural Materials: Fatigue and Creep | | | Gruber, Gumbsch |

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

**Competence Certificate**
oral exam ca. 30 minutes

no tools or reference materials

**Prerequisites**
none

**Recommendation**
preliminary knowlegde in mathematics, mechanics and materials science

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

## V Failure of Structural Materials: Fatigue and Creep

2181715, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
1 Fatigue
1.1 Introduction
1.2 Lifetime
1.3 Fatigue Mechanisms
1.4 Material Selection
1.5 Notches and Shape Optimization
1.6 Case Studies: ICE-Accidents

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.

**Literature**

- Engineering Materials, M. Ashby and D.R. Jones (2nd Edition, Butterworth-Heinemann, Oxford, 1998); sehr lesenswert, relativ einfach aber dennoch umfassend, verständlich
- Mechanical Behavior of Materials, Thomas H. Courtney (2nd Edition, McGraw Hill, Singapur); Klassiker zu den mechanischen Eigenschaften der Werkstoffe, umfangreich, gut
- Bruchvorgänge in metallischen Werkstoffen, D. Aurich (Werkstofftechnische Verlagsgesellschaft Karlsruhe), relativ einfach aber dennoch umfassender Überblick für metallische Werkstoffe
- Fatigue of Materials, Subra Suresh (2nd Edition, Cambridge University Press); Standardwerk über Ermüdung, alle Materialklassen, umfangreich, für Einsteiger und Fortgeschrittene

# T 8.82 Course: Fatigue of Materials [T-MACH-112106]

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

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2173586 | Fatigue of Materials | 2 SWS | Lecture / 🗣 | Guth |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-112106 | Fatigue of Materials | | | Guth |
| WT 24/25 | 76-T-MACH-112106 | Fatigue of Materials | | | Guth |

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

**Competence Certificate**
Oral exam, about 20 minutes

**Prerequisites**
none

**Recommendation**
Basic knowledge in Materials Science will be helpful.

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

## V Fatigue of Materials

2173586, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

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

**learning objectives:**

The students are able to recognise the deformation and the failure behaviour of materials under cyclic loading and to assign it to the basic microstructural processes. They know the sequence and the development of fatigue damages and can evaluate the initiation and the growth of fatigue cracks.

The students can evaluate the cyclic strength behaviour of materials and components both qualitatively and quantitatively and know the procedures for the assessment of single-stage, multistage and stochastic cyclical loadings.

**requirements:**

none, basic knowledge in Material Science will be helpful

**workload**:

regular attendance: 21 hours
self-study: 99 hours

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

# T 8.83 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-102816 - Major Field: Fundamentals of Energy Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2189910 | Flows and Heat Transfer in Energy Technology | 2 SWS | Lecture / 🗣 | Cheng |
| WT 24/25 | 2189911 | Tutorial 'Flows and Heat Transfer in Energy Technology ' | 1 SWS | Practice / 🗣 | Cheng, Mitarbeiter |

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

**Competence Certificate**
oral exam, 20 min

**Prerequisites**
none

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

## V Flows and Heat Transfer in Energy Technology

2189910, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
This lecture is dedicated to students of mechanical engineering and other engineering Bachelor or Master degree courses. Goal of the lecture is the understanding of major processes in fluid dynamics and heat transfer in energy engineering. Through this lecture the students are capable of understanding the important physical processes and the selection of suitable methods for the analysis of the processes. With the discussion of some practical examples, the students can analyze the pressure drop and heat transfer in energy engineering systems.

1. collection of sample applications
2. heat transfer and its application
3. convective fluid dynamics and heat transfer
4. thermal radiation and its application
5. special cases

**Literature**

- Bahr, H.D., Stephan, K., Wärme- und Stoffübertragung, 3. Auflage Springer Verlag, 1998

# T 8.84 Course: Fluid Mechanics 1&2 [T-MACH-105207]

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

**Part of:** M-MACH-102565 - Fluid Mechanics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 8 | Grade to a third | Each summer term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2154512 | Fluid Mechanics I | 3 SWS | Lecture / Practice ( / 🗣 | Frohnapfel |
| ST 2024 | 3154510 | Fluid Mechanics I | 3 SWS | Lecture / Practice ( / 🗣 | Frohnapfel |
| WT 24/25 | 2153512 | Fluid Mechanics II | 3 SWS | Lecture / Practice ( / 🗣 | Frohnapfel |
| WT 24/25 | 3153511 | Fluid Mechanics II | 3 SWS | Lecture / Practice ( / 🗣 | Frohnapfel |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105207 | Fluid Mechanics (1+2) | | | Frohnapfel, Kriegseis |
| ST 2024 | 76-T-MACH-105207 engl. | Fluid Mechanics 1&2 | | | Frohnapfel |

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

**Competence Certificate**
written exam 3 hours

**Prerequisites**
none

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

## V Fluid Mechanics I

2154512, SS 2024, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**
Properties of fluids, surface tension, hydro- and aerostatics, kinematics, stream tube theory (compressible and incompressible), losses in pipeline systems, dimensional analysis, dimensionless numbers

**Literature**
Zierep, J., Bühler, K.: Strömungsmechanik, Springer Lehrbuch bzw. entsprechende Kapitel in Hütte.Das Ingenieurwissen, Springer

## V Fluid Mechanics I

3154510, SS 2024, 3 SWS, Language: English, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**
Properties of fluids, surface tension, hydro- and aerostatics, kinematics, stream tube theory (compressible and incompressible), losses in pipeline systems, dimensional analysis, dimensionless numbers

**Literature**
Zierep, J., Bühler, K.: Principles of Fluid Mechanics, Springer, 2022

## V Fluid Mechanics II

2153512, WS 24/25, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**
The students know how to derive the fundamental equations for mass and momentum conservation and can introduce material laws for fluids into those. They can discuss the physical meaning of the different terms in the Navier-Stokes-Equations. They are capable of simplifying the mathematical equations that describe the motion of fluids and can compute flow quantities for generic problems based on these simplified equations. This includes the calculation of static and dynamic forces acting from the fluid onto the solid as well as the detailed analysis of two-dimensional viscous flows.

tensor notation, fluid elements in continuum, Reynolds transport theorem, conservation of mass and momentum, continuity equation, constitutive law for Newtonian fluids, Navier-Stokes equations, angular momentum and energy conservation, integral form of the conservation equations, forces between fluids and solids, analytical solutions of the Navier-Stokes equations

**Literature**
Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Durst, F.: Grundlagen der Strömungsmechanik, Springer, 2006

Oertel, H.: Strömungsmechanik, Vieweg-Verlag, 4. Auflage 2006
Oertel, H., Böhle, M.: Übungsbuch Strömungsmechanik, Vieweg-Verlag, 5. Auflage 2006

Zierep, J., Bühler, K.: Strömungsmechanik, Springer Lehrbuch bzw. entsprechende Kapitel in Hütte.Das Ingenieurwissen, Springer

V

## Fluid Mechanics II

3153511, WS 24/25, 3 SWS, Language: English, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**
The students know how to derive the fundamental equations for mass and momentum conservation and can introduce material laws for fluids into those. They can discuss the physical meaning of the different terms in the Navier-Stokes-Equations. They are capable of simplifying the mathematical equations that describe the motion of fluids and can compute flow quantities for generic problems based on these simplified equations. This includes the calculation of static and dynamic forces acting from the fluid onto the solid as well as the detailed analysis of two-dimensional viscous flows.

tensor notation, fluid elements in continuum, Reynolds transport theorem, conservation of mass and momentum, continuity equation, constitutive law for Newtonian fluids, Navier-Stokes equations, angular momentum and energy conservation, integral form of the conservation equations, forces between fluids and solids, analytical solutions of the Navier-Stokes equations

**Literature**
Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Durst, F.: Grundlagen der Strömungsmechanik, Springer, 2006

Oertel, H.: Strömungsmechanik, Vieweg-Verlag, 4. Auflage 2006
Oertel, H., Böhle, M.: Übungsbuch Strömungsmechanik, Vieweg-Verlag, 5. Auflage 2006

Zierep, J., Bühler, K.: Strömungsmechanik, Springer Lehrbuch bzw. entsprechende Kapitel in Hütte.Das Ingenieurwissen, Springer

# T 8.85 Course: Fluid Power Systems [T-MACH-102093]

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

**Part of:** M-MACH-102746 - Compulsory Elective Module
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2114093 | Fluid Technology | 2 SWS | Lecture / 🗣 | Geimer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102093 | Fluid Power Systems | | | Geimer |
| WT 24/25 | 76-T-MACH-102093 | Fluid Power Systems | | | Geimer |

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

**Competence Certificate**
The assessment consists of a oral exam 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 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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.

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

**Literature**
Skriptum zur Vorlesung *Fluidtechnik*
Institut für Fahrzeugsystemtechnik
downloadbar

# T 8.86 Course: Foundry Technology [T-MACH-105157]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2174575 | Foundry Technology | 2 SWS | Lecture / ✕ | Klan, Günther |

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

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

**Prerequisites**
none

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

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

## V Foundry Technology

2174575, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Cancelled**

**Organizational issues**
Die Vorlesung ist abgesagt!

**Literature**
Literaturhinweise werden in der Vorlesung gegeben

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

# T 8.87 Course: Fuels and Lubricants for Engine Powertrains [T-MACH-111623]

**Responsible:** Hon.-Prof. Dr. Bernhard Ulrich Kehrwald
Dr.-Ing. Heiko Kubach

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2133108 | Fuels and Lubricants for Combustion Engines | 2 SWS | Lecture / 🗣 | Kehrwald |

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

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

**Prerequisites**
none

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

## V Fuels and Lubricants for Combustion Engines

2133108, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
electric drives and fuel cell drives with the associated operating materials will also be presented

- Introduction, basics, primary energy and energy chains
- Illustrative chemistry of hydrocarbons
- Fossil fuels, exploration, processing, standards
- Operating materials not fossil, renewable, alternative
- Fuels, lubricants, coolants, AdBlue
- Laboratory analysis, testing, test benches and measurement technology
- Excursion to test fields for motorized drives from 0.5 to 3,500 kW

**Literature**
Skript

# T 8.88 Course: Fundamentals for Design of Motor-Vehicle Bodies I [T-MACH-102116]

**Responsible:** Dipl.-Ing. Horst Dietmar Bardehle
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 2 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113814 | Fundamentals for Design of Motor-Vehicles Bodies I | 1 SWS | Lecture / 🗣 | Bardehle |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102116 | Fundamentals for Design of Motor-Vehicle Bodies I | | | Bardehle, Unrau |
| WT 24/25 | 76-T-MACH-102116 | Fundamentals for Design of Motor-Vehicle Bodies I | | | Bardehle |

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

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

**Lecture (V)**
**On-Site**

**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

Learning Objectives:

The students have an overview of the fundamental possibilities for design and manufacture of motor-vehicle bodies. They know the complete process, from the first idea, through the concept to the dimensioned drawings (e.g. with FE-methods). They have knowledge about the fundamentals and their correlations, to be able to analyze and to judge relating components as well as to develop them accordingly.

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

Termine und nähere Informationen: siehe ILIAS oder Institutshomepage

Dates and further information will be published on the homepage of the institute

**Literature**

1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg

# T 8.89 Course: Fundamentals for Design of Motor-Vehicle Bodies II [T-MACH-102119]

**Responsible:** Dipl.-Ing. Horst Dietmar Bardehle
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 2 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114840 | Fundamentals for Design of Motor-Vehicles Bodies II | 1 SWS | Lecture / 🗣 | Bardehle |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102119 | Fundamentals for Design of Motor-Vehicle Bodies II | | | Bardehle, Gauterin |
| WT 24/25 | 76-T-MACH-102119 | Fundamentals for Design of Motor-Vehicle Bodies II | | | Bardehle |

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

**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 2024, 1 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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

Learning Objectives:

The students know that, often the design of seemingly simple detail components can result in the solution of complex problems. They have knowledge in testing procedures of body properties. They have an overview of body parts such as bumpers, window lift mechanism and seats. They understand, as well as, parallel to the normal electrical system, about the electronic side of a motor vehicle. Based on this they are ready to analyze and to judge the relation of these single components. They are also able to contribute competently to complex development tasks by imparted knowledge in project management.

**Organizational issues**
Voraussichtliche Termine, nähere Informationen und evtl. Änderungen:

siehe Institutshomepage.

Scheduled dates, further Information and possible changes of date:

see homepage of the institute.

**Literature**

1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg

# T 8.90 Course: Fundamentals in the Development of Commercial Vehicles [T-MACH-111389]

**Responsible:** Christof Weber
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

| Type | Credits | Grading scale | Recurrence | Expansion | Version |
|---|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | see Annotations | 2 terms | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114844 | Fundamentals in the Development of Commercial Vehicles II | 1 SWS | Lecture / 🗣 | Weber |
| WT 24/25 | 2113812 | Fundamentals in the Development of Commercial Vehicles I | 1 SWS | Lecture / 🗣 | Weber |
| **Exams** | | | | | |
| ST 2024 | 76T-MACH-111389 | Fundamentals in the Development of Commercial Vehicles | | | Weber |
| WT 24/25 | 76T-MACH-111389 | Fundamentals in the Development of Commercial Vehicles | | | Weber |

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

**Competence Certificate**
Oral group examination

Duration: appr. 30 minutes

Auxiliary means: none

**Prerequisites**
none

**Annotation**
Fundamentals in the Development of Commercial Vehicles I, WT

Fundamentals in the Development of Commercial Vehicles II, ST

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

## V Fundamentals in the Development of Commercial Vehicles II

2114844, SS 2024, 1 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
1. Gear boxes of commercial vehicles
2. Intermediate elements of the drive train
3. Axle systems
4. Front axles and driving dynamics
5. Chassis and axle suspension
6. Braking System
7. Systems
8. Excursion

Learning Objectives:

The students know the advantages and disadvantages of different drives. Furthermore they are familiar with components, such as transfer box, propeller shaft, powered and non-powered frontaxle etc. Beside other mechanical components, such as chassis, axle suspension and braking system, also electric and electronic systems are known. Consequently the student are able to analyze and to judge the general concepts as well as to adjust them precisely with the area of application.

**Organizational issues**
Genaue Termine sowie nähere Informationen und eventuelle Terminänderungen:

siehe Institutshomepage.

**Literature**
1.HILGERS, M.: Nutzfahrzeugtechnik lernen, Springer Vieweg, ISSN: 2510-1803

2.SCHITTLER, M.; HEINRICH, R.; KERSCHBAUM, W.: Mercedes-Benz Baureihe 500 – neue V-Motorengeneration für schwere Nutzfahrzeuge, MTZ 57 Nr. 9, S. 460 ff, 1996

3.Robert Bosch GmbH (Hrsg.): Bremsanalgen für Kraftfahrzeuge, VDI-Verlag, Düsseldorf, 1. Auflage, 1994

4.RUBI, V.; STRIFLER, P. (Hrsg. Institut für Kraftfahrwesen RWTH Aachen): Indiustrielle Nutzfahrzeugentwicklung, Schriftenreihe Automobiltechnik, 1993

5.TEUTSCH, R.; CHERUTI, R.; GASSER, R.; PEREIRA, M.; de SOUZA, A.; WEBER, C.: Fuel Efficiency Optimization of Market Specific Truck Applications, Proceedings of the 5th Commercial Vehicle Technology Symposium – CVT 2018

## V Fundamentals in the Development of Commercial Vehicles I

**Lecture (V)**
**On-Site**

2113812, WS 24/25, 1 SWS, Language: German, Open in study portal

**Content**
1. Introduction, definitions, history

2. Development tools

3. Complete vehicle

4. Cab, bodyshell work

5. Cab, interior fitting

6. Alternative drive systems

7. Drive train

8. Drive system diesel engine

9. Intercooled diesel engines

Learning Objectives:

The students have proper knowledge about the process of commercial vehicle development starting from the concept and the underlying original idea to the real design. They know that the customer requirements, the technical realisability, the functionality and the economy are important drivers.

The students are able to develop parts and components. Furthermore they have knowledge about different cab concepts, the interior and the interior design process. Consequently they are ready to analyze and to judge concepts of commercial vehicles as well as to participate competently in the commercial vehicle development.

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

Termine und Nähere Informationen: siehe ILIAS oder Institutshomepage

Dates and further information will be published on the homepage of the institute.

**Literature**
1. Marwitz, H., Zittel, S.: ACTROS -- die neue schwere Lastwagenbaureihe von Mercedes-Benz, ATZ 98, 1996, Nr. 9

2. Alber, P., McKellip, S.: ACTROS -- Optimierte passive Sicherheit, ATZ 98, 1996

3. Morschheuser, K.: Airbag im Rahmenfahrzeug, ATZ 97, 1995, S. 450 ff.

# T 8.91 Course: Fundamentals of Automobile Development I [T-MACH-105162]

**Responsible:** Dr. Manfred Harrer
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 2 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113810 | Fundamentals of Automobile Development I | 1 SWS | Lecture / 🗣 | Harrer |
| WT 24/25 | 2113851 | Principles of Whole Vehicle Engineering I | 1 SWS | Lecture / 🗣 | Harrer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105162 | Fundamentals of Automobile Development I | | | Frech, Gießler |

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

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

**Lecture (V)**
**On-Site**

**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

Learning Objecitves:

The students have an overview of the fundamentals of the development of automobiles. They know the development process, the national and the international legal requirements that are to be met. They have knowledge about the thermo-management, aerodynamics and the design of an automobile. They are ready to judge goal conflicts in the field of automobile development and to work out approaches to solving a problem.

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

Termine und nähere Informationen finden Sie auf der Institutshomepage.

Kann nicht mit Lehrveranstaltung 2113851 kombiniert werden.

Date and further information will be published on the homepage of the institute.

Cannot be combined with lecture 2113851.

**Literature**
Skript zur Vorlesung wird zu Beginn des Semesters ausgegeben

The scriptum will be provided during the first lessons

### V Principles of Whole Vehicle Engineering I

**Lecture (V)**
**On-Site**

2113851, WS 24/25, 1 SWS, Language: English, Open in study portal

**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

Learning Objectives:

The students have an overview of the fundamentals of the development of automobiles. They know the development process, the national and the international legal requirements that are to be met. They have knowledge about the thermo-management, aerodynamics and the design of an automobile. They are ready to judge goal conflicts in the field of automobile development and to work out approaches to solving a problem.

**Organizational issues**
*You will find the lecture material on ILIAS. To get the ILIAS password, KIT students refer to https://fast-web-01.fast.kit.edu/Passwoerterllias/*

Termine und nähere Informationen finden Sie auf der Institutshomepage.

Dats and further information will be published on the homepage of the institute.

Kann nicht mit Lehrveranstaltung 2113810 kombiniert werden

Cannot be combined with lecture 2113810.

**Literature**
Skript zur Vorlesung wird zu Beginn des Semesters ausgegeben

The scriptum will be provided during the first lessons

# T 8.92 Course: Fundamentals of Automobile Development II [T-MACH-105163]

**Responsible:** Dr. Manfred Harrer
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114842 | Principles of Whole Vehicle Engineering II | 1 SWS | Block / 🗣 | Frech |
| ST 2024 | 2114860 | Principles of Whole Vehicle Engineering II | 1 SWS | / 🗣 | Frech |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105163 | Fundamentals of Automobile Development II | | | Frech, Gießler |

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

**Competence Certificate**
Written examination

Duration: 90 minutes

Auxiliary means: none

**Prerequisites**
none

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

## V Principles of Whole Vehicle Engineering II

2114842, SS 2024, 1 SWS, Language: German, Open in study portal

**Block (B)**
**On-Site**

**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

Learning Objectives:

The students are familiar with the selection of appropriate materials and the choice of adequate production technology. They have knowledge of the acoustical properties of the automobiles, covering both the interior sound and exterior noise. They have an overview of the testing procedures of the automobiles. They know in detail the evaluation of the properties of the complete automobile. They are ready to participate competently in the development process of the complete vehicle.

**Organizational issues**
Vorlesung findet als Blockvorlesung an folgenden Terminen statt: 02.05., 16.05., 06.06. 2024, jeweils von 08:00 bis 11:00 Uhr.

Die Vorlesung findet im Sommersemester 2024 zum letzten Mal statt.

Kann nicht mit der Veranstaltung [2114860] kombiniert werden.

Cannot be combined with lecture [2114860].

**Literature**
Skript zur Vorlesung ist über ILIAS verfügbar.

V

## Principles of Whole Vehicle Engineering II

2114860, SS 2024, 1 SWS, Language: English, Open in study portal

**On-Site**

**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

Learning Objectives:

The students are familiar with the selection of appropriate materials and the choice of adequate production technology. They have knowledge of the acoustical properties of the automobiles, covering both the interior sound and exterior noise. They have an overview of the testing procedures of the automobiles. They know in detail the evaluation of the properties of the complete automobile. They are ready to participate competently in the development process of the complete vehicle.

**Organizational issues**

Veranstaltung findet als Blockvorlesung an folgenden Terminen statt: 02.05., 16.05,, 06.06.2024 von 11:15 bis 14:00 Uhr.

Scheduled dates:

see homepage of the institute.

The lecture will be offered for the last time in summer semester 2024!

Kann nicht mit der Veranstaltung [2114842] kombiniert werden.

Cannot be combined with lecture [2114842].

**Literature**

Das Skript zur Vorlesung ist über ILIAS verfügbar.

# T 8.93 Course: Fundamentals of Catalytic Exhaust Gas Aftertreatment [T-MACH-105044]

**Responsible:** Prof. Dr. Olaf Deutschmann
Prof. Dr. Jan-Dierk Grunwaldt
Dr.-Ing. Heiko Kubach
Hon.-Prof. Dr. Egbert Lox

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2134138 | Fundamentals of catalytic exhaust gas aftertreatment | 2 SWS | Lecture / 🗣 | Lox, Grunwaldt, Deutschmann |

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

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

**Prerequisites**
none

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

## V Fundamentals of catalytic exhaust gas aftertreatment

2134138, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Organizational issues**
Blockvorlesung, Termin und Ort werden auf Ilias sowie der Homepage des IFKM und ITCP bekannt gegeben.

# T 8.94 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-102746 - Compulsory Elective Module
M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2133123 | Fundamentals of Combustion Engine Technology | 2 SWS | Lecture / 🗣 | Kubach, Wagner, Toedter, Pfeil, Bernhardt, Velji |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105652 | Fundamentals of Combustion Engine Technology | | | Kubach |

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

**Competence Certificate**
written exam, 60 min.

**Prerequisites**
none

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-112799 - Fundamentals of Combustion Engine Technology must not have been started.

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

## V Fundamentals of Combustion Engine Technology

2133123, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Fundamentals of engine processes
Components of combustion engines
Mixture formation systems
Gasexchange systems
Injection systems
Exhaust Gas Aftertreatment Systems
Cooling systems
Ignistion Systems

# T 8.95 Course: Fundamentals of Combustion Engine Technology [T-MACH-112799]

**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-102645 - Major Field: Combustion Engine Techniques

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

| Exams | | | |
|---|---|---|---|
| ST 2024 | 76-T-MACH-105652(SP) | Fundamentals of Combustion Engine Technology | Kubach |

**Competence Certificate**
oral exam, 30 min

**Prerequisites**
none

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105652 - Fundamentals of Combustion Engine Technology must not have been started.

# T 8.96 Course: Fundamentals of Combustion I [T-MACH-105213]

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

**Part of:** M-MACH-102746 - Compulsory Elective Module
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2165515 | Fundamentals of Combustion I | 2 SWS | Lecture / | Maas, Shrotriya |
| WT 24/25 | 2165517 | Fundamentals of Combustion I (Tutorial) | 1 SWS | Practice / | Bykov |
| WT 24/25 | 3165016 | Fundamentals of Combustion I | 2 SWS | Lecture / | Maas |
| WT 24/25 | 3165017 | Fundamentals of Combustion I (Tutorial) | 1 SWS | Practice / | Bykov |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105213 | Fundamentals of Combustion I | | | Maas |
| ST 2024 | 76-T-MACH-105464 | Fundamentals of Combustion I | | | Maas |
| WT 24/25 | 76-T-MACH-105213 | Fundamentals of Combustion I - german exam | | | Maas |
| WT 24/25 | 76-T-MACH-105464 | Fundamentals of Combustion I - english exam | | | Maas |

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

**Competence Certificate**
Written exam, approx. 3 hours

**Prerequisites**
none

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

## V Fundamentals of Combustion I

2165515, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NOx formation
- Formation of hydrocarbons and soot

**Organizational issues**
Bei zu wenigen Hörern wird die Lehrveranstaltung mit der englischen Lehrveranstaltung zusammengelegt.

**Literature**
Vorlesungsskript,

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

V

### Fundamentals of Combustion I (Tutorial)

2165517, WS 24/25, 1 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Literature**

- Vorlesungsskript
- J. Warnatz; U. Maas; R.W. Dibble: Verbrennung, Springer, Heidelberg 1996

V

### Fundamentals of Combustion I

3165016, WS 24/25, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NOx formation
- Formation of hydrocarbons and soot

**Literature**

Vorlesungsskript,

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

# T 8.97 Course: Fundamentals of Combustion II [T-MACH-105325]

**Responsible:** Dr. Viatcheslav Bykov
Prof. Dr. Ulrich Maas

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2166538 | Fundamentals of combustion II | 2 SWS | Lecture / 🗣 | Maas |
| ST 2024 | 2166539 | Übung zu Grundlagen der technischen Verbrennung II | 1 SWS | Practice / 🗣 | Maas |
| ST 2024 | 3166550 | Fundamentals of Combustion II | 2 SWS | Lecture / 🗣 | Maas, Shrotriya, Bykov |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105325 | Fundamentals of Combustion II | | | Maas |

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

**Competence Certificate**
Oral exam, approx. 20 min

**Prerequisites**
none

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

## V Fundamentals of combustion II

2166538, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- Three dimensional Navier-Stokes equations for reacting flows
- Turbulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

**Literature**
Vorlesungsskript;

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch; Heidelberg, Karlsruhe, Berkley 2006

## V Übung zu Grundlagen der technischen Verbrennung II

2166539, SS 2024, 1 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Calculation and Simulation of combustion processes

**Literature**
Skript Grundlagen der technischen Verbrennung (I+II) von Prof. Dr. rer. nat. habil. U. Maas
Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

V

## Fundamentals of Combustion II

3166550, SS 2024, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- Three dimensional Navier-Stokes equations for reacting flows
- Tubulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

**Organizational issues**
Time and location will be announced on the website and at the institute showcase.

**Literature**
Vorlesungsskript;

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch; Heidelberg, Karlsruhe, Berkley 2006

# T 8.98 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-102816 - Major Field: Fundamentals of Energy Technology

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2130927 | Fundamentals of Energy Technology | 3 SWS | Lecture / 🗣 | Cheng, Badea |
| ST 2024 | 3190923 | Fundamentals of Energy Technology | 3 SWS | Lecture / 🗣 | Badea |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105220 | Fundamentals of Energy Technology | | | Cheng, Badea |
| ST 2024 | 76-T-MACH-105220 Fundamentals of Energy Technology | Fundamentals of Energy Technology | | | Badea |
| WT 24/25 | 76-T-MACH-105220 | Fundamentals of Energy Technology | | | Badea, Cheng |

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

**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 2024, 3 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
The objective of the course is to train the students on state of the art knowledge about the challenging fields of energy industry and the permanent competition between the economical profitability and the long-term sustainability. The students obtain basic knowledge on thermodynamics relevant to the energy sector and comprehensive knowledge on the energy sector: demand, energy types, energy mix, installations for energy production (conventional, nuclear and renewable), transport and energy storage, environmental impact and future tendencies. Students are able to use methods of economic efficiency optimization for the energy sector in a creative way, practice oriented, also specifically trained during the corresponding tutorial. The students are qualified for further training in energy engineering related fields and for (also research-related) professional activity in the energy sector.

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

V

## Fundamentals of Energy Technology

3190923, SS 2024, 3 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

The objective of the course is to train the students on state of the art knowledge about the challenging fields of energy industry and the permanent competition between the economical profitability and the long-term sustainability. The students obtain basic knowledge on thermodynamics relevant to the energy sector and comprehensive knowledge on the energy sector: demand, energy types, energy mix, installations for energy production (conventional, nuclear and renewable), transport and energy storage, environmental impact and future tendencies. Students are able to use methods of economic efficiency optimization for the energy sector in a creative way, practice oriented, also specifically trained during the corresponding tutorial. The students are qualified for further training in energy engineering related fields and for (also research-related) professional activity in the energy sector.

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

# T 8.99 Course: Gear Cutting Technology [T-MACH-102148]

**Responsible:** Hon.-Prof. Dr. Markus Klaiber
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2149655 | Gear Technology | 2 SWS | Lecture / 🗣 | Klaiber |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-102148 | Gear Technology | | | Klaiber |

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

**Competence Certificate**
Oral Exam (20 min)

**Prerequisites**
none

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

## V Gear Technology

2149655, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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.

**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

**Literature**
**Medien:**
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.100 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-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113807 | Handling Characteristics of Motor Vehicles I | 2 SWS | Lecture / | Unrau |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105152 | Handling Characteristics of Motor Vehicles I | | | Unrau |
| WT 24/25 | 76-T-MACH-105152 | Handling Characteristics of Motor Vehicles I | | | Unrau |

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

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

**Lecture (V)**
**Online**

**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

Learning Objectives:

The students know the basic connections between drivers, vehicles and environment. They can build up a vehicle simulation model, with which forces of inertia, aerodynamic forces and tyre forces as well as the appropriate moments are considered. They have proper knowledge in the area of tyre characteristics, since a special meaning comes to the tire behavior during driving dynamics simulation. Consequently they are ready to analyze the most importent influencing factors on the driving behaviour and to contribute to the optimization of the handling characteristics.

**Organizational issues**
*Die Vorlesung wird als Videostream zur Verfügung gestellt. Sie finden den Videostream und das Vorlesungsmaterial auf ILIAS. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/PasswoerterIlias/*

**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.: Umdrucksammlung zur Vorlesung Fahreigenschaften von Kraftfahrzeugen I

# T 8.101 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-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114838 | Handling Characteristics of Motor Vehicles II | 2 SWS | Lecture / | Unrau |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105153 | Handling Characteristics of Motor Vehicles II | | | Unrau |
| WT 24/25 | 76-T-MACH-105153 | Handling Characteristics of Motor Vehicles II | | | Unrau |

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

**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 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Online**

**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

Learning Objectives:

The students have an overview of common test methods, with which the handling of vehicles is gauged. They are able to interpret results of different stationary and transient testing methods. Apart from the methods, with which e.g. the driveability in curves or the transient behaviour from vehicles can be registered, also the influences from cross-wind and from uneven roadways on the handling characteristics are well known. They are familiar with the stability behavior from single vehicles and from vehicles with trailer. Consequently they are ready to judge the driving behaviour of vehicles and to change it by specific vehicle modifications.

**Organizational issues**
*Die Vorlesung wird als Videostream zur Verfügung gestellt. Sie finden den Videostream und das Vorlesungsmaterial auf ILIAS. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/PasswoerterIlias/*

**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.: Umdrucksammlung zur Vorlesung Fahreigenschaften von Kraftfahrzeugen II

# T 8.102 Course: Heat and Mass Transfer [T-MACH-105292]

**Responsible:** Prof. Dr. Ulrich Maas
Dr.-Ing. Chunkan Yu

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102746 - Compulsory Elective Module

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 3122512 | Heat and Mass Transfer | 2 SWS | Lecture / 🗣 | Maas |
| WT 24/25 | 2165512 | Heat and mass transfer | 2 SWS | Lecture / 🗣 | Yu, Maas |
| WT 24/25 | 2165513 | Heat and Mass Transfer (Tutorial) | 2 SWS | Practice / 🗣 | Yu, Maas, Bykov |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105292 | Heat and Mass Transfer | | | Maas |
| WT 24/25 | 76-T-MACH-105292 | Heat and Mass Transfer | | | Maas |

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

**Competence Certificate**
Written exam, approx. 3 h

**Prerequisites**
none

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

## V Heat and Mass Transfer

3122512, SS 2024, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**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

**Organizational issues**
Bitte beachten Sie den Aushang.

**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

## V Heat and mass transfer

2165512, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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

**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


V **Heat and Mass Transfer (Tutorial)** **Practice (Ü) On-Site**

2165513, WS 24/25, 2 SWS, Language: German, Open in study portal

# T 8.103 Course: Human Factors Engineering I [T-MACH-105518]

**Responsible:** Prof. Dr.-Ing. Barbara Deml
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102589 - Major Field: Production Systems

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2109035 | Human Factors Engineering I: Ergonomics | 2 SWS | Lecture / 🗣 | Deml |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105518 | Human Factors Engineering I | | | Deml |
| WT 24/25 | 76-T-MACH-105518 | Human Factors Engineering I | | | Deml |

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

**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

2109035, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester on Wednesday and Thursday.

In the second half of the semester 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).

**Organizational issues**
Die Veranstaltung "Arbeitswissenschaft I: Ergonomie" findet in der ersten Hälfte des Semesters am Mittwoch und Donnerstag bis zum 12.12.2024 statt.

Ab dem 18.12.2024 findet die Veranstaltung "Arbeitswissenschaft II: Arbeitsorganisation" am Mittwoch und Donnerstag statt.

- schriftliche Prüfung

- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).

**Mit einer gültigen KIT-E-Mail-Adresse können Sie das Passwort bei elisabeth.schlund@kit.edu schriftlich erfragen.**

**Literature**
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.

# T 8.104 Course: Human Factors Engineering II [T-MACH-105519]

**Responsible:** Prof. Dr.-Ing. Barbara Deml
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102589 - Major Field: Production Systems

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2109036 | Human Factors Engineering II: Work Organisation | 2 SWS | Lecture / 🗣 | Deml |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105519 | Human Factors Engineering II | | | Deml |
| WT 24/25 | 76-T-MACH-105519 | Human Factors Engineering II | | | Deml |

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

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

**Lecture (V)**
**On-Site**

**Content**
The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester on Wednesday and Thursday.

In the second half of the semester the course "Human Factors Engineering II: Work Organisation" takes place on Wednesday and Thursday.

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.

**Organizational issues**
Die Veranstaltung "Arbeitswissenschaft I: Ergonomie" findet in der ersten Hälfte des Semesters am Mittwoch und Donnerstag statt.

In der zweiten Hälfte, ab dem Donnerstag, dem 18.12.2024 findet die Veranstaltung "Arbeitswissenschaft II: Arbeitsorganisation" am Mittwoch und Donnerstag statt.

- schriftliche Prüfung

- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).

**Mit einer gültigen KIT-E-Mail-Adresse können Sie das Passwort bei elisabeth.schlund@kit.edu schriftlich erfragen.**

**Literature**
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.

# T 8.105 Course: Human-Machine-Interaction [T-INFO-101266]

**Responsible:** Prof. Dr.-Ing. Michael Beigl
**Organisation:** KIT Department of Informatics
**Part of:** M-MACH-102820 - Major Field: Mechatronics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 6 | Grade to a third | Each summer term | 3 |

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 24659 | Human-Computer-Interaction | 2 SWS | Lecture / 🏵 | Beigl, Lee |
| **Exams** | | | | | |
| ST 2024 | 7500048 | Human-Machine-Interaction | | | Beigl |
| WT 24/25 | 7500076 | Human-Machine-Interaction | | | Beigl |

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

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-INFO-106257 - Human-Machine-Interaction Pass must have been passed.

# T 8.106 Course: Human-Machine-Interaction Pass [T-INFO-106257]

**Responsible:** Prof. Dr.-Ing. Michael Beigl
**Organisation:** KIT Department of Informatics
**Part of:** M-MACH-102820 - Major Field: Mechatronics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 0 | pass/fail | Each summer term | 1 |

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2400095 | Human-Computer-Interaction | 1 SWS | Practice / | Beigl, Lee |
| ST 2024 | 24659 | Human-Computer-Interaction | 2 SWS | Lecture / | Beigl, Lee |
| **Exams** | | | | | |
| ST 2024 | 7500121 | Human-Machine-Interaction | | | Beigl |

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

# T 8.107 Course: Hybrid and Electric Vehicles [T-ETIT-100784]

**Responsible:** Prof. Dr. Martin Doppelbauer
**Organisation:** KIT Department of Electrical Engineering and Information Technology
**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102820 - Major Field: Mechatronics

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2306321 | Hybrid and Electric Vehicles | 2 SWS | Lecture / | Doppelbauer |
| WT 24/25 | 2306323 | Tutorial for 2306323 Hybrid and Electric Vehicles | 1 SWS | Practice / | Doppelbauer |
| **Exams** | | | | | |
| ST 2024 | 7306321 | Hybrid and Electric Vehicles | | | Doppelbauer |
| WT 24/25 | 7306321 | Hybrid and Electric Vehicles | | | Doppelbauer |

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

**Prerequisites**
none

# T 8.108 Course: Hydraulic Fluid Machinery [T-MACH-105326]

**Responsible:** Dr. Balazs Pritz
**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2157432 | Hydraulic Fluid Machinery | 4 SWS | Lecture / 🗣 | Pritz |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105326 | Hydraulic Fluid Machinery | | | Pritz |
| WT 24/25 | 76-T-MACH-105326 | Hydraulic Fluid Machinery | | | Pritz |

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

**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 2024, 4 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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

**Recommendations:**

3154510 – Fluid Mechanics I

3153511 – Fluid Mechanics II

Students get to know the basics of hydraulic fluid machinery (pumps, fans, hydroturbines, windturbines, hydrodynamic transmissions) in general. Application of the knowledge in different fields of engineering.

The lecture introduces the basics of Hydraulic Fluid Machinery. The different types and shapes are presented. The basic equations for the preservation of mass, momentum and energy are discussed. Velocity schemes in typical cascades are shown, the Euler equation of fluid machinery and performance characteristics are deduced.
Similarities and dimensionless parameters are discussed. Fundamental aspects of operation and cavitation are shown.

Students are able to understand the working principle of Hydraulic Fluid Machinery as well as the interaction with typical systems, in which they are integrated.

regular attendance: 56 hours
self-study: 150 hours

preparation for exam: 40 hours

Oral or written examination (see anouncement)
No tools or reference materials may be used during the exam.

**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 8.109 Course: Hydrogen and reFuels - Energy Conversion in Combustion Engines [T-MACH-111585]

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

**Part of:** M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2134155 | Hydrogen and reFuels - Energy Conversion in Combustion Engines | 2 SWS | Lecture / 🗣 | Koch |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105564 | Hydrogen and reFuels - Energy Conversion in Combustion Engines | | | Koch, Kubach |

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

**Competence Certificate**
oral exam, appr. 25 minutes, no auxillary means

**Prerequisites**
none

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

## V Hydrogen and reFuels - Energy Conversion in Combustion Engines

2134155, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
New types of CO2-neutral fuels such as gaseous hydrogen but also liquid synthetic fuels often place specific requirements on engine systems that differ significantly from operation with conventional fuels. These special aspects of engine energy conversion are dealt with in this lecture.

Introduction

Thermodynamics of combustion engines

Fundamentals

gas exchange

Flow field

Wall heat losses

Combustion in gasoline engines

Pressure Trace Analysis

Combustion in Diesel engines

Specific Topics of Hydrogen Combsution

Waste heat recovery

# T 8.110 Course: I4.0 Systems Platform [T-MACH-106457]

**Responsible:** Dipl.-Ing. Thomas Maier
Prof. Dr.-Ing. Jivka Ovtcharova

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102583 - Major Field: Information Management

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2123900 | I4.0 Systems platform | 4 SWS | Project (P / 🗣 | Meyer, Maier |
| WT 24/25 | 2123900 | I4.0 Systems platform | 4 SWS | Project (P / 🗣 | Meyer, Rönnau, Maier |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-106457 | I4.0 Systems platform | | | Meyer |

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

**Competence Certificate**
Alternative exam assessment (project work)

**Prerequisites**
None

**Annotation**
Limited number of participants.

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

## V I4.0 Systems platform

2123900, SS 2024, 4 SWS, Language: German, Open in study portal

**Project (PRO)**
**On-Site**

**Content**
Industry 4.0, IT systems for fabrication (e.g.: CAx, PDM, CAM, ERP, MES), process modelling and execution, project work in teams, practice-relevant I4.0 problems, in automation, manufacturing industry and service.

Students can

- describe the fundamental concepts, challenges, and objectives of Industrie 4.0 and name the essential terms in context of information management
- explain the necessary information flow between the different IT systems. They get practically knowledge about using current IT systems in context of I4.0, from order to production.
- map and analyze processes in the context of Industry 4.0 with special methods of process modelling
- collaboratively grasp practical I4.0 issues using existing hardware and software and work out solutions for a continuous improvement process in a team
- prototypically implement the self-developed solution proposal with the given IT systems and the existing hardware equipment and finally present the results

**Literature**
Keine / None

## V I4.0 Systems platform

2123900, WS 24/25, 4 SWS, Language: German, Open in study portal

**Project (PRO)**
**On-Site**

**Content**
Industry 4.0, IT systems for fabrication (e.g.: CAx, PDM, CAM, ERP, MES), process modelling and execution, project work in teams, practice-relevant I4.0 problems, in automation, manufacturing industry and service.

Students can

- describe the fundamental concepts, challenges, and objectives of Industrie 4.0 and name the essential terms in context of information management
- explain the necessary information flow between the different IT systems. They get practically knowledge about using current IT systems in context of I4.0, from order to production.
- map and analyze processes in the context of Industry 4.0 with special methods of process modelling
- collaboratively grasp practical I4.0 issues using existing hardware and software and work out solutions for a continuous improvement process in a team
- prototypically implement the self-developed solution proposal with the given IT systems and the existing hardware equipment and finally present the results

**Organizational issues**
Auftakt: Mi 23 Okt 10:00h - G20.20 (EG) R061

**Literature**
Keine / None

# T 8.111 Course: Ignition Systems [T-MACH-105985]

**Responsible:** Dr.-Ing. Olaf Toedter
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques
M-MACH-102838 - Major Field: Energy Converting Engines

| Type | Credits | Grading scale | Version |
|---|---|---|---|
| Oral examination | 4 | Grade to a third | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2133125 | Ignition systems | 2 SWS | Lecture / 🗣 | Toedter |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105985 | Ignition systems | | | Toedter |

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

**Competence Certificate**
oral exam, 20 min

**Prerequisites**
none

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

## V Ignition systems

2133125, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- 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 8.112 Course: Industrial Aerodynamics [T-MACH-105375]

**Responsible:** Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Stefan Kröber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2153425 | Industrial aerodynamics | 2 SWS | / | Kröber, Frohnapfel |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105375 | Industrial Aerodynamics | | | Kröber |
| WT 24/25 | 76-T-MACH-105375 | Industrial Aerodynamics | | | Kröber |

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

**Competence Certificate**
oral exam - 30 minutes

**Prerequisites**
none

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

## V Industrial aerodynamics

2153425, WS 24/25, 2 SWS, Language: German, Open in study portal **Blended (On-Site/Online)**

**Content**
This compact lecture deals with flows and aeroacoustics with significance in vehicle development. A special focus is set on the optimization of external vehicle aerodynamics and the presentation of modern industrial wind tunnel technology. The second major thematic block includes both, aeroacoustic basics principles and practical examples of aeroacoustics, especially in the field of automotive technology. These fields are explained in their phenomenology, the corresponding theories are discussed and the tools for measurement and simulation are introduced and demonstrated. This lecture focusses on industry relevant methods for analyses and descriptions of forces, aeroacoustic sound fields, flow structures and turbulence. In addition, an overview of numerical methods for industrial applications is given. The integration and interconnection of the methods in the development processes are discussed exemplary.
An excursion to the Mercedes-Benz AG wind tunnel and the research and development centers is planned.

- Introduction
- Aerodynamics of bluff bodies
- Industrial flow measurement techniques and modern wind tunnel technology
- Overview of flow simulation in automotive industry
- Vehicle aerodynamics
- Passenger comfort of roadsters and cabriolets
- Soiling of road vehicles
- Aeroacoustics: basic principles and practical examples of aeroacoustics, especially in the field of automotive technology including aeroacoustic measurement techniques and numerical methods

Students can describe the different properties of aerodynamics and aeroacoustics of vehicles flows. They are qualified to analyze external flows around the vehicles and aeroacoustic sound fields of vehicles.

**Organizational issues**
Blockvorlesung - Anmeldung erfolgt über das Sekretariat, max. Teilnehmerzahl sind 20 Studierende.

**Literature**
Vorlesungsskript

# T 8.113 Course: Information Engineering [T-MACH-102209]

**Responsible:** Prof. Dr.-Ing. Anne Meyer
Prof. Dr.-Ing. Jivka Ovtcharova

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102583 - Major Field: Information Management

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Examination of another type | 3 | Grade to a third | Each term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2122014 | Information Engineering | 2 SWS | Seminar / | Meyer, Mitarbeiter |
| WT 24/25 | 2121355 | Information Engineering | 2 SWS | Seminar / | Meyer, Rönnau |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102209 | Information Engineering | | | Meyer, Rönnau, Ovtcharova |

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

**Competence Certificate**
Alternative exam assessment (written composition and speech)

**Prerequisites**
None

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

## V Information Engineering

2122014, SS 2024, 2 SWS, Language: German/English, Open in study portal

**Seminar (S)**
**Blended (On-Site/Online)**

**Content**
Seminar papers on current research topics of the Institute for Information Management in Engineering. The respective topics are presented at the beginning of each semester.

**Organizational issues**
Siehe ILIAS-Kurs

**Literature**
Themenspezifische Literatur

## V Information Engineering

2121355, WS 24/25, 2 SWS, Language: German/English, Open in study portal

**Seminar (S)**
**Blended (On-Site/Online)**

**Content**
Seminar papers on current research topics of the Institute for Information Management in Engineering. The respective topics are presented at the beginning of each semester.

**Organizational issues**
Ort und Zeit siehe ILIAS

**Literature**
Themenspezifische Literatur

# T 8.114 Course: Information Systems and Supply Chain Management [T-MACH-102128]

**Responsible:** Dr.-Ing. Christoph Kilger
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102583 - Major Field: Information Management
M-MACH-102817 - Major Field: Information Technology

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

**Competence Certificate**
The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

**Prerequisites**
none

# T 8.115 Course: Innovation and Project Management in Rail Vehicle Engineering [T-MACH-113068]

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

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

| Type | Credits | Grading scale | Version |
|---|---|---|---|
| Examination of another type | 4 | Grade to a third | 4 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2115921 | Innovation and Project Management with Case Study "Innovative Rail Vehicle" | 2 SWS | Lecture / 🗣 | Cichon, Berthold |
| WT 24/25 | 2115921 | Innovation and Project Management in Rail Vehicle Engineering | 2 SWS | Lecture / 🗣 | Cichon |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-106427 | Innovation and Project Management in Rail Vehicle Engineering | | | Cichon, Berthold |
| WT 24/25 | 76-T-MACH-106427 | Innovation and Project Management in Rail Vehicle Engineering | | | Cichon |

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

**Competence Certificate**
2/3 of the examination: approx. 20-page elaboration on project management based on a practical case study including the development and application of own project management tools
1/3 of the examination: presentation of a creativity technique and its practical application as part of a 10-minute presentation

# T 8.116 Course: Innovation2Business – Innovation Strategy in the Industrial Corporate Practice [T-MACH-112882]

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

**Part of:** M-MACH-102583 - Major Field: Information Management
M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2145182 | Innovation2Business – Innovation Strategy in the Industrial Corporate Practice | 2 SWS | Lecture / 🗣 | Albers |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-112882 | Innovation2Business – innovation strategy in the industrial corporate practice | | | Albers |

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

**Competence Certificate**
Written exam based on the lecture handout and materials, duration 90 minutes

**Prerequisites**
none

**Recommendation**
None

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

## V Innovation2Business – Innovation Strategy in the Industrial Corporate Practice

**Lecture (V) On-Site**

2145182, WS 24/25, 2 SWS, Language: German/English, Open in study portal

**Content**
lecture block at the Bühl & Herzogenaurach locations with plant tours & fireside evenings + exam-preparatory Q&A.
Exam: written, limited to 30 seats (recommended for: Master's degree; mechanical engineering, industrial engineering, electrical engineering, computer science) → see module manual for details.
In this lecture series, use Schaeffler as an example to learn how global companies continuously transform themselves to grow sustainably and become
maintain a leading position in the global market in the long term through business-oriented innovation.
Together we will go through the most important elements of the innovation and development process and learn about the successes and learnings based on
vivid examples from practice.
Join the fireside evenings with the speakers to discuss the lecture content and beyond in a relaxed atmosphere.
The event is limited to 30 students and is free for you (meals, bus transfers & accommodations).

**Organizational issues**
Vorlesung findet an Schaeffler-Standorten (Herzogenaurach und Bühl) statt.

Sprache: Unterlagen Englisch, Vortragssprache Deutsch

# T 8.117 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-102583 - Major Field: Information Management
M-MACH-102589 - Major Field: Production Systems
M-MACH-102746 - Compulsory Elective Module

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2121001 | Integrated Information Systems for engineers | 3 SWS | Lecture / Practice ( / 🗣 | Elstermann, Meyer |
| WT 24/25 | 2121001 | Integrated Information Systems for engineers | 3 SWS | Lecture / Practice ( / 🗣 | Elstermann |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102083 | Integrated Information Systems for Engineers | | | Ovtcharova, Elstermann |

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

**Competence Certificate**
Oral examination 20 min.

**Prerequisites**
None

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

## V Integrated Information Systems for engineers

2121001, SS 2024, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**

- Information systems, information management
- CAD, CAP and CAM systems
- PPS, ERP and PDM systems
- Knowledge management and ontology
- Process modeling

Students can:

- illustrate the structure and operating mode of information systems
- describe the structure of relational databases
- describe the fundamentals of knowledge management and its application in engineering and deploy ontology as knowledge representation
- describe different types of process modelling and their application and illustrate and execute simple work flows and processes with selected tools
- explain different goals of specific IT systems in product development (CAD, CAP, CAM, PPS, ERP, PDM) and assign product development processes

**Literature**
Vorlesungsfolien / lecture slides

## V Integrated Information Systems for engineers

2121001, WS 24/25, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**

- Information systems, information management
- CAD, CAP and CAM systems
- PPS, ERP and PDM systems
- Knowledge management and ontology
- Process modeling

Students can:

- illustrate the structure and operating mode of information systems
- describe the structure of relational databases
- describe the fundamentals of knowledge management and its application in engineering and deploy ontology as knowledge representation
- describe different types of process modelling and their application and illustrate and execute simple work flows and processes with selected tools
- explain different goals of specific IT systems in product development (CAD, CAP, CAM, PPS, ERP, PDM) and assign product development processes

**Organizational issues**
Blockveranstaltung vom 07. - 10. Oktober

**Literature**
Vorlesungsfolien / lecture slides

# T 8.118 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-102589 - Major Field: Production Systems

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 8 | Grade to a third | Each summer term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2150660 | Integrated Production Planning in the Age of Industry 4.0 | 6 SWS | Lecture / Practice ( / 🗣 | Lanza |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-108849 | Integrated Production Planning in the Age of Industry 4.0 | | | Lanza |
| WT 24/25 | 76-T-MACH-108849 | Integrated Production Planning in the Age of Industry 4.0 | | | Lanza |

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

**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**
2150660, SS 2024, 6 SWS, Language: German, Open in study portal
**Lecture / Practice (VÜ)**
**On-Site**

**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 (PPS, process simulation as a validation tool, planning of conveyor technology and storage systems for linking production and IT systems in the I4.0 factory )
- Preparation and monitoring of implementation
- Start-up and series support

The lecture contents are complemented by numerous current practical examples with a strong Industry 4.0 reference. Aspects of sustainability are anchored in all units and thus basic knowledge of sustainable production planning is taught. 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 to new problems.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques 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.
- know the basic features of sustainable production planning and can apply underlying knowledge.

**Workload:**

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

**Organizational issues**
Vorlesungstermine dienstags 14.00 Uhr und donnerstags 14.00 Uhr, Übungstermine donnerstags 15.45 Uhr. Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung

**Literature**
**Medien:**
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.119 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-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2150601 | Integrative Strategies in Production and Development of High Performance Cars | 2 SWS | Lecture / 🗣 | Schlichtenmayer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105188 | Integrative Strategies in Production and Development of High Performance Cars | | | Schlichtenmayer |
| WT 24/25 | 76-T-MACH-105188 | Integrative Strategies in Production and Development of High Performance Cars | | | Schlichtenmayer |

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

**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)
On-Site

2150601, SS 2024, 2 SWS, Language: German, Open in study portal

**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

**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

**Literature**
**Medien**:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.120 Course: Intellectual Property Rights and Strategies in Industrial Companies [T-MACH-105442]

**Responsible:** Prof. Dr.-Ing. Tobias Düser
Dipl.-Ing. Frank Zacharias

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102583 - Major Field: Information Management
M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2147160 | Patents and Patentstrategies in innovative companies | 2 SWS | / 🗣 | Zacharias |
| WT 24/25 | 2147161 | Intellectual Property Rights and Strategies in Industrial Companies | 2 SWS | Block / 🗣 | Zacharias |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105442 | Intellectual Property Rights and Strategies in Industrial Companies | | | Zacharias |
| WT 24/25 | 76-T-MACH-105442 | Intellectual Property Rights and Strategies in Industrial Companies | | | Zacharias, Albers |

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

**Competence Certificate**
oral exam (ca. 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 2024, 2 SWS, Language: German, Open in study portal **On-Site**

**Content**
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

## V Intellectual Property Rights and Strategies in Industrial Companies

**Block (B)**
**On-Site**

2147161, WS 24/25, 2 SWS, Language: German, Open in study portal

**Content**
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

**Organizational issues**
Weitere Informationen siehe IPEK-Homepage.
https://www.ipek.kit.edu/2976_2858.php

# T 8.121 Course: Introduction into Mechatronics [T-MACH-100535]

**Responsible:** Andre Orth
apl. Prof. Dr. Markus Reischl

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102746 - Compulsory Elective Module
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2105011 | Introduction into Mechatronics | 3 SWS | Lecture / | Reischl, Orth |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-100535 | Introduction into Mechatronics | | | Reischl |

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

**Competence Certificate**
Oral exam (Duration: 2h)

**Prerequisites**
none

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

## V Introduction into Mechatronics

2105011, WS 24/25, 3 SWS, Language: German, Open in study portal

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

**Content**
**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.

**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 8.122 Course: Introduction to Ceramics [T-MACH-100287]

**Responsible:** apl. Prof. Dr. Günter Schell
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 6 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2125757 | Introduction to Ceramics | 3 SWS | Lecture / | |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-100287 | Introduction to Ceramics | | | Schell, Bucharsky, Wagner |
| WT 24/25 | 76-T-MACH-100287 | Introduction to Ceramics | | | Schell, Bucharsky, Wagner |

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

**Competence Certificate**
The assessment consists of an oral exam (30 min) taking place at a specific date.

The re-examination is offered at a specific date.

**Prerequisites**
None

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

## V Introduction to Ceramics

2125757, WS 24/25, 3 SWS, Language: German, Open in study portal

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

**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 8.123 Course: Introduction to Computational Fluid Dynamics [T-MACH-110362]

**Responsible:** Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Alexander Stroh

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102582 - Major Field: Continuum Mechanics
M-MACH-102746 - Compulsory Elective Module

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2154533 | Introduction to Computational Fluid Dynamics | 2 SWS | Lecture / | Stroh, Frohnapfel |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-110362 | Introduction to Computational Fluid Dynamics | | | Stroh |

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

**Competence Certificate**
written 90min

**Prerequisites**
Passing the "Tutorial Introduction to Computational Fluid Dynamics" (T-MACH-111033) is prerequisite for taking part in the exam.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-111033 - Tutorial Introduction to Computational Fluid Dynamics must have been passed.

**Annotation**
Knowledge of the contents of the courses "Continuum Mechanics of Solid and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials is expected.

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

## V Introduction to Computational Fluid Dynamics

2154533, SS 2024, 2 SWS, Language: German, Open in study portal

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

**Content**

- Introduction and Motivation, Fundamental Equations and Dimensionless Numbers
- Turblence and Modelling (DNS, LES, RANS);
- Numerical Solution of the Navier Stokes Equations:
  Discretization and Solution Approaches (FDM, FVM), boundary and initial conditions, stability, mistakes in numerics and modelling
- Set-up of a numerical simulation: pre- and postprocessing, validation, result evaluation, discussion of results
- Introduction to open-source toolbox OpenFOAM:
  set-up of simulation, generation of numerical grid with different tools, data evaluation within OpenFOAM and with python;
- Introduction to a research oriented toolbox for turbulent flows (DNS based o Incompact3d): set-up of simulation, statistical evaluation and analysis with MATLAB und python;
- visualisization of simulation results in ParaView

This course includes a lecture and a computer course.

**Organizational issues**
Die Kenntnis der Vorlesungsinhalte "Kontinuumsmechanik der Festkörper und Fluide" sowie "Mathematische Methoden der Kontinuumsmechanik" wird vorausgesetzt.

**Literature**
Wird in der Vorlesung bekannt gegeben.

# T 8.124 Course: Introduction to High Temperature Materials [T-MACH-111258]

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

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2194724 | Introduction to High Temperature Materials | 2 SWS | Lecture / 🗣 | Gorr |

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

**Competence Certificate**
oral examination (ca. 30 Minuten)

**Prerequisites**
none

**Recommendation**
Knowledge from the basic materials science lecture

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

## V Introduction to High Temperature Materials

2194724, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Oral examination (about 30 min)

Teaching content:

- Applications and requirements for high temperature materials
- High temperature corrosion (thermodynamics, oxidation kinetics, oxidation of alloys, protection of high temperature materials)
- Creep (creep curve, creep mechanisms, creep of solid-solution strengthened materials, creep of particle hardened alloys, life time prediction)
- Fatigue (fundamentals, life time prediction)
- Thermo-mechanical fatigue
- High-temperature materials (Ni-, Fe-, Co- Ti-based alloys, ODS materials)

Qualification targets:

The students acquire fundamental knowledge about high temperature corrosion, creep, high temperature fatigue and thermomechanical fatigue as well as resulting failure mechanisms.

Recommendations:

Basic course in materials science and engineering

**Organizational issues**
Anmeldung verbindlich bis zum 14.04.2023 unter bronislava.gorr@kit.edu

**Literature**

- Bürgel: Handbuch Hochtemperaturwerkstofftechnik, 3. Auflage, Vieweg, 2006
- Rösler, H. Harders, M. Bäker: Mechanisches Verhalten der Werkstoffe, 2. Auflage, Teubner, 2006
- J. Young, High temperature oxidation and corrosion of metals, Elsevier, 2008
- Skript in elektronischer Form verfügbar.

# T 8.125 Course: Introduction to Multi-Body Dynamics [T-MACH-105209]

**Responsible:** Dr.-Ing. Ulrich Römer
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102746 - Compulsory Elective Module
M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102820 - Major Field: Mechatronics
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162235 | Introduction to Multibody Dynamics | 3 SWS | Lecture / | Römer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105209 | Introduction to Multibody Dynamics | | | Römer |

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

**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 to Multibody Dynamics

2162235, SS 2024, 3 SWS, Language: German, Open in study portal

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

**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

**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 Systems.
Kane, T.: Dynamics of rigid bodies.

# T 8.126 Course: Introduction to Nonlinear Vibrations [T-MACH-105439]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104442 - Major Field: Vibration Theory

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 7 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2162247 | Introduction to Nonlinear Vibrations | 2 SWS | Lecture / 🗣 | Fidlin |
| WT 24/25 | 2162248 | Introduction into the nonlinear vibrations (Tutorial) | 2 SWS | Practice / 🗣 | Fidlin, Singhal |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105439 | Introduction to Nonlinear Vibrations | | | Fidlin |

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

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

**Lecture (V)**
**On-Site**

**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

**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)

2162248, WS 24/25, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Exercises related to the lecture

# T 8.127 Course: Introduction to Nuclear Energy [T-MACH-105525]

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

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2189903 | Introduction to Nuclear Energy | 2 SWS | Lecture / 🗣 | Cheng |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105525 | Introduction to Nuclear Energy | | | Cheng |

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

**Competence Certificate**
oral exam, 30 min

**Prerequisites**
none

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

## V Introduction to Nuclear Energy

2189903, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
This lecture is dedicated to students of mechanical engineering and other engineering Bachelor or Master degree courses. Goal of the lecture is the fundamental knowledge of nuclear energy and nuclear reactors. After the lecture the students understand the principle of the usage of nuclear energy, the structure and operation of nuclear power plants and nuclear safety measures. Furthermore, the students are capable of giving technical assessment of the usage of nuclear energy with respect to its safety and sustainability.

# T 8.128 Course: Introduction to Numerical Fluid Dynamics [T-MACH-105515]

**Responsible:** Dr. Balazs Pritz
**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
**Part of:** M-MACH-102838 - Major Field: Energy Converting Engines

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 4 | pass/fail | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2157444 | Introduction to numerical fluid dynamics | 2 SWS | Practical course / 🗣 | Pritz |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105515 | Introduction to Numerical Fluid Dynamics | | | Pritz |
| WT 24/25 | 76-T-MACH-105515 | Introduction to Numerical Fluid Dynamics | | | Pritz |

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

**Competence Certificate**
Certificate of participation

**Prerequisites**
none

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

## V Introduction to numerical fluid dynamics

2157444, WS 24/25, 2 SWS, Language: German, Open in study portal

**Practical course (P)**
**On-Site**

**Content**
The lab gives an overview of the application of computational fluid dynamics (CFD). At the end of the course the students will be able to perform CFD calculations independently.

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

Regular attendance: 22,5 hours
Self-study: 97,5 hours

Lecture notes/handouts are offered.

Learning objectives:

Students

- know the three components of CFD: mesh generation, calculation and evaluation.
- will be able to create simple geometries and generate mesh.
- can set up and carry out simulations.
- know the ways of evaluating the results and the possibilities of flow visualization.
- know how to analyze flow situations.

**Literature**
Praktikumsskript

# T 8.129 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-102582 - Major Field: Continuum Mechanics
M-MACH-102746 - Compulsory Elective Module

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162282 | Introduction to the Finite Element Method | 2 SWS | Lecture / 🗣 | Langhoff, Böhlke |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105320 | Introduction to the Finite Element Method | | | Böhlke, Langhoff |

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

**Competence Certificate**
written exam (90 min)

prerequisites: passing the corresponding "Tutorial to Introduction to the Finite element method" (T-MACH-110330)

**Prerequisites**
Passing the "Tutorial to Introduction to the Finite element method" (T-MACH-110330) is a prerequisite for taking part in the exam.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-110330 - Tutorial Introduction to the Finite Element Method must have been passed.

**Annotation**
Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) will be admitted to the computer tutorials in any case.
If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

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

## V Introduction to the Finite Element Method

2162282, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- introduction and motivation, elements of tensor calculus
- Discrete FEM: systems of bars and springs
- Formulations of boundary value problems (1D)
- Approximations in FEM
- FEM for scalar and vector-valued field problems
- Solution methods for linear systems of equations

**Literature**


- Fish, J., Belytschko, T.: A First Course in Finite Elements, Wiley 2007
- Jung, M., Langer, U.: Methode der finiten Elemente für Ingenieure: Eine Einführung in die numerischen Grundlagen und Computersimulation, Teubner 2013
- Braess, D.: Finite Elemente -- Theorie, schnelle Löser und Anwendungen in der Elastizitätstheorie, Springer 2013
- Gustafsson, B.: Fundamentals of Scientific Computing, Springer 2011

# T 8.130 Course: IT-Fundamentals of Logistics [T-MACH-105187]

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

**Part of:**
M-MACH-102583 - Major Field: Information Management
M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics
M-MACH-102821 - Major Field: Technical Logistics

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

**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 8.131 Course: Lab Computer-Aided Methods for Measurement and Control [T-MACH-105341]

**Responsible:** Marvin Klemp
Prof. Dr.-Ing. Christoph Stiller

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102817 - Major Field: Information Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 4 | pass/fail | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2137306 | Lab Computer-aided methods for measurement and control | 3 SWS | Practical course / 🗣 | Stiller, Immel |

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

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

**Practical course (P)**
**On-Site**

**Content**
**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.

**Nachweis (EN):**

Colloquia

**Literature**
Übungsanleitungen sind auf der Institutshomepage erhältlich.

Instructions to the experiments are available on the institute's website

# T 8.132 Course: Laboratory Exercise in Energy Technology [T-MACH-105331]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
Prof. Dr. Ulrich Maas
Dr.-Ing. Heinrich Wirbser

**Organisation:** KIT Department of Mechanical Engineering

Institute of Thermal Turbomachinery

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 4 | pass/fail | Each term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2171487 | Laboratory Exercise in Energy Technology | 3 SWS | Practical course / 🗣 | Bauer, Maas, Bykov, Schießl |
| WT 24/25 | 2171487 | Laboratory Exercise in Energy Technology | 3 SWS | Practical course / 🗣 | Bauer, Maas, Bykov |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105331 | Laboratory Exercise in Energy Technology | | | Bauer, Maas, Wirbser |
| WT 24/25 | 76-T-MACH-105331 | Laboratory Exercise in Energy Technology | | | Bauer, Maas, Wirbser, Bykov |

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

**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 2024, 3 SWS, Language: German/English, Open in study portal

**Practical course (P)**
**On-Site**

**Content**
Online registration within the first two weeks of the lecture periode at: http://www.its.kit.edu

- 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

regular attendance: 42h
self-study: 78h

Attending this course enables the students to:

- accomplish experimental and design related as well as theoretical tasks in a scientific background
- perform a correct evaluation of the obtained results
- adequately document and present their results in a scientific framework

1 report, approx. 12 pages

Discussion of the documented results with the assistents

Duration: 30 minutes

no tools or reference materials may be used

**Organizational issues**
Information zum Lehrlabor finden Sie auf der Instituts-homepage

V **Laboratory Exercise in Energy Technology** **Practical course (P)**
2171487, WS 24/25, 3 SWS, Language: German/English, Open in study portal **On-Site**

**Content**
Online registration within the first two weeks of the lecture periode at: http://www.its.kit.edu

- 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

regular attendance: 42h
self-study: 78h

Attending this course enables the students to:

- accomplish experimental and design related as well as theoretical tasks in a scientific background
- perform a correct evaluation of the obtained results
- adequately document and present their results in a scientific framework

1 report, approx. 12 pages

Discussion of the documented results with the assistents

Duration: 30 minutes

no tools or reference materials may be used

# T 8.133 Course: Laboratory Laser Materials Processing [T-MACH-102154]

**Responsible:** Dr.-Ing. Johannes Schneider
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2183640 | Laboratory "Laser Materials Processing" | 3 SWS | Practical course / | Schneider, Pfleging |
| WT 24/25 | 2183640 | Laboratory "Laser Materials Processing" | 3 SWS | Practical course / | Schneider, Pfleging |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102154 | Laboratory Laser Materials Processing | | | Schneider |
| WT 24/25 | 76-T-MACH-102154 | Laboratory Laser Materials Processing | | | Schneider |

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

**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 is assumed.

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

## V Laboratory "Laser Materials Processing"

2183640, SS 2024, 3 SWS, Language: German, Open in study portal

**Practical course (P)**
**Blended (On-Site/Online)**

**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.

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.

**Organizational issues**
Die Praktikumsplätze für das Sommersemester 2024 sind bereits ausgebucht!

Anmeldung per Email an johannes.schneider@kit.edu

Das Praktikum findet semesterbegleitend in Kleingruppen am IAM-ZM (CS) bzw. IAM-AWP (CN) statt!

Die Termine werden zu Beginn des Semesters bekannt gegeben.

**Literature**
F. K. Kneubühl, M. W. Sigrist: Laser, 2008, Vieweg+Teubner

T. Graf: Laser - Grundlagen der Laserstrahlquellen, 2009, Vieweg-Teubner Verlag

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

H. Hügel, T. Graf: Laser in der Fertigung, 2009, Vieweg+Teubner

J. Eichler, H.-J. Eichler: Laser - Bauformen, Strahlführung, Anwendungen, 2006, Springer

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 24/25, 3 SWS, Language: German, Open in study portal **Blended (On-Site/Online)**

**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.

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.

**Organizational issues**
Maximal 16 Teilnehmer/innen!
Es sind nur noch wenige Plätze frei (Stand 31.05.2024)! Registrierung für die Nachrückliste möglich per Email an johannes.schneider@kit.edu
Praktikum findet in Kleingruppen semesterbegleitend (dienstags bzw. mittwochs, halbtägig) auf dem Campus Nord am IAM-AWP (Geb. 681) und auf dem Campus Süd am IAM-CMS (Geb. 30.48) statt!

Termine werden mit den Teilnehmern/innen direkt abgestimmt.

**Literature**
F. K. Kneubühl, M. W. Sigrist: Laser, 2008, Vieweg+Teubner

T. Graf: Laser - Grundlagen der Laserstrahlquellen, 2009, Vieweg-Teubner Verlag

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

H. Hügel, T. Graf: Laser in der Fertigung, 2009, Vieweg+Teubner

J. Eichler, H.-J. Eichler: Laser - Bauformen, Strahlführung, Anwendungen, 2006, Springer

# T 8.134 Course: Laboratory Mechatronics [T-MACH-105370]

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

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2105014 | Laboratory mechatronics | 3 SWS | Practical course / 🗣 | Hagenmeyer, Stiller, Chen, Orth, Klemp |

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

**Competence Certificate**
The laboratory course is offered exclusively as ungraded course work. The assessment consists of a group colloquium at the beginning of the individual specialization phases (Part 1). In addition, a robot control system for a pick-and-place task must be successfully implemented in the group phase (Part 2).

**Prerequisites**
None

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

## V Laboratory mechatronics

2105014, WS 24/25, 3 SWS, Language: German, Open in study portal

**Practical course (P)**
**On-Site**

**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

**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.

Nachweis (EN): certificate of successful attendance

Voraussetzung (EN): none

Arbeitsaufwand (EN):

regular attendance: 33.5 h

self-study: 88.5 h

**Organizational issues**
Das Praktikum ist anmeldepflichtig.

Die Anmeldungsmodalitäten-/fristen werden auf https://www.iai.kit.edu/Pruefungen.php bekannt gegeben.

**Literature**

Materialien zum Mechatronik-Praktikum

Manuals for the laboratory course on Mechatronics

# T 8.135 Course: Laboratory Production Metrology [T-MACH-108878]

**Responsible:** Prof. Dr.-Ing. Gisela Lanza
Dr. Florian Stamer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102589 - Major Field: Production Systems
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2150550 | Laboratory Production Metrology | 3 SWS | Practical course / 🗣 | Lanza, Stamer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-108878 | Laboratory Production Metrology | | | Lanza, Stamer |

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

**Competence Certificate**
Alternative Test Achievement: Group presentation of 15 min at the beginning of each experiment and evaluation of the participation during the experiments

and

Oral Exam (15 min)

**Prerequisites**
none

**Annotation**
For organizational reasons the number of participants for the course is limited. Hence al selection process will take place. Applications are made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

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

## V Laboratory Production Metrology

2150550, SS 2024, 3 SWS, Language: German, Open in study portal

**Practical course (P)**
**On-Site**

**Content**
During this course, students get to know measurement systems that are used in a production system. In the age of Industry 4.0, sensors are becoming more important. Therefore, the application of in-line measurement technology such as machine vision and non-destructive testing is focussed. Additionally, laboratory based measurement technologies such as computed tomography are addressed. The students learn the theoretical background as well as practical applications for industrial examples. The students use sensors by themselves during the course. Additionally, they are trained on how to integrate sensors in production processes and how to analyze measurement data with suitable software.

The following topics are addressed:

- Classification and examples for different measurement technologies in a production environment
- Machine vision with optical sensors
- Information fusion based on optical measurements
- Robot-based optical measurements
- Non-destructive testing by means of acoustic measurements
- Coodinate measurement technology
- Industrial computed tomography
- Measurement uncertainty evaluation
- Analysis of production data by means of data mining

**Learning Outcomes:**

The students …

- are able to name, describe and mark out different measurement technologies that are relevant in a production environment.
- are able to conduct measurements with the presented in-line and laboratory based measurement systems.
- are able to analyze measurement results and asses the measurement uncertainty of these.
- are able to deduce whether a work piece fulfills quality relevant specifications by analysing measurement results.
- are able to use the presented measurement technologies for a new task.

**Workload:**

regular attendance: 31,5 hours
self-study: 88,5 hours

**Organizational issues**
Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Die Bewerbung erfolgt über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

For organizational reasons the number of participants for the course is limited. Hence a selection process will take place. Applications are made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

**Literature**
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt. Ebenso wird auf gängie Fachliteratur verwiesen.

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/). Additional reference to literature will be provided, as well.

# T 8.136 Course: Large Diesel and Gas Engines for Ship Propulsions [T-MACH-110816]

**Responsible:** Dr.-Ing. Heiko Kubach
**Organisation:**
**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2134154 | Large Diesel and Gas Engines for Ship Propulsions | 2 SWS | Lecture / 🗣 | Weisser |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-110816 | Großdiesel- und -gasmotoren für Schiffsantriebe | | | Weisser |

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

**Competence Certificate**
oral exam, 20 minutes

**Prerequisites**
None

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

## V Large Diesel and Gas Engines for Ship Propulsions

2134154, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- Introduction and History
- Types of Ships amd Propulsion Systems
- Thermodynamic
- Boosting
- Design
- Fuels
- Lubricants
- Injection of liquid Fuels
- Combustions Processes for liquid Fuels
- Injection of Gaseous Fuels
- Combustion Processes for Gaseous Fuels
- Emissions
- Integration of Engines in Ships
- Large Engines in other Applications

**Organizational issues**
ACHTUNG: abweichend von den hier aufgeführten regelmäßigen Mittwoch-Terminen muss die Vorlesung als Blockveranstaltung in KW 29 durchgeführt werden. Genaue Informationen entnehmen Sie bitte dem entsprechenden Iliaskurs.

# T 8.137 Course: Laser in Automotive Engineering [T-MACH-105164]

**Responsible:** Dr.-Ing. Johannes Schneider
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2182642 | Laser Material Processing | 2 SWS | Lecture / 🗣 | Schneider |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105164 | Laser in Automotive Engineering / Laser Material Processing | | | Schneider |
| WT 24/25 | 76-T-MACH-105164 | Laser in Automotive Engineering | | | Schneider |

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

**Competence Certificate**
oral examination (30 min)

no tools or reference materials

**Prerequisites**
It is not possible, to combine this brick with brick Laser Material Processing [T-MACH-112763], 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-112763 - Laser Material Processing 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 Material Processing

2182642, SS 2024, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in material processing
- savety aspects

The student

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of Nd:YAG-, CO2- and high power diode-laser sources.
- can describe the most important methods of laser-based processing in automotive engineering and illustrate the influence of laser, material and process parameters
- can analyse manufacturing problems and is able to choose a suitable laser source and process parameters.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

It is not possible, to combine this lecture with the lecture *Physical basics of laser technology* [2181612].

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

oral examination (ca. 30 min)

no tools or reference materials

**Organizational issues**
Die Vorlesung ersetzt die bisherige Vorlesung "Lasereinsatz im Automobilbau" und wird jetzt auf Englisch angeboten!

The lecture replaces the previous lecture "Laser Application in Automotive Engineering" and is now offered in English!

**Literature**
W. T. Silvast: Laser Fundamentals, 2004, Cambridge University Press

J. Eichler, H.-J. Eichler: Laser - Basics, Advances, Applications, 2018, Springer

P. Poprawe: Tailored Light 1, 2018, Springer

K. F. Renk: Basics of Laser Physics, 2017, Springer

M. W. Sigrist: Laser: Theorie, Typen und Anwendungen, 2018, Springer-Spektrum

H. Hügel, T. Graf: Materialbearbeitung mit Laser, 2022, Springer Vieweg

T. Graf: Laser - Grundlagen der Laserstrahlquellen, 2009, Vieweg-Teubner Verlag

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

# T 8.138 Course: Laser Material Processing [T-MACH-112763]

**Responsible:** Dr.-Ing. Johannes Schneider
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2182642 | Laser Material Processing | 2 SWS | Lecture / 🗣 | Schneider |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-112763 | Laser Material Processing | | | Schneider |
| WT 24/25 | 76-T-MACH-112763 | Laser Material Processing | | | Schneider |

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

**Competence Certificate**
oral examination (30 min)

no tools or reference materials

**Prerequisites**
It is not possible, to combine this brick with Laser in Automotive Engineering [T-MACH-105164], brick Physical Basics of Laser Technology [T-MACH-109084] and brick Physical Basics of Laser Technology [T-MACH-102102].

**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-105164 - Laser in Automotive Engineering 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 Material Processing

2182642, SS 2024, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in material processing
- savety aspects

The student

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of Nd:YAG-, CO2- and high power diode-laser sources.
- can describe the most important methods of laser-based processing in automotive engineering and illustrate the influence of laser, material and process parameters
- can analyse manufacturing problems and is able to choose a suitable laser source and process parameters.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

It is not possible, to combine this lecture with the lecture *Physical basics of laser technology* [2181612].

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

oral examination (ca. 30 min)

no tools or reference materials

**Organizational issues**
Die Vorlesung ersetzt die bisherige Vorlesung "Lasereinsatz im Automobilbau" und wird jetzt auf Englisch angeboten!

The lecture replaces the previous lecture "Laser Application in Automotive Engineering" and is now offered in English!

**Literature**
W. T. Silvast: Laser Fundamentals, 2004, Cambridge University Press

J. Eichler, H.-J. Eichler: Laser - Basics, Advances, Applications, 2018, Springer

P. Poprawe: Tailored Light 1, 2018, Springer

K. F. Renk: Basics of Laser Physics, 2017, Springer

M. W. Sigrist: Laser: Theorie, Typen und Anwendungen, 2018, Springer-Spektrum

H. Hügel, T. Graf: Materialbearbeitung mit Laser, 2022, Springer Vieweg

T. Graf: Laser - Grundlagen der Laserstrahlquellen, 2009, Vieweg-Teubner Verlag

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

# T 8.139 Course: Leadership and Conflict Management [T-MACH-105440]

**Responsible:** Hans Hatzl
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2110017 | Leadership and Conflict Management (in German) | 2 SWS | Lecture / 🗣 | Hatzl |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105440 | Leadership and Conflict Management | | | Deml, Hatzl |

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

**Competence Certificate**
oral exam (approx. 30 min)

**Prerequisites**
It is not possible to combine this brick with brick Leadership and Conflict Management [T-MACH-111070].

**Annotation**
This lecture will also be offered once in winter term 20/21.

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

## V Leadership and Conflict Management (in German)

2110017, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
In this compact event, management and leadership techniques are taught which are among the key qualifications for management tasks. Furthermore, you will be prepared for management and leadership tasks.

The course consists of the following course contents:

1. Introduction to the topic
   Goal setting and goal achievement
   Management techniques in planning
   Communication and information
   Decision Theory
   Leadership and cooperation
   Self Management
   Conflict management and strategy
   Case studies

It passes:

- Obligatory attendance

recommendations:

- Knowledge of work and economic science is advantageous

**Literature**
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.

# T 8.140 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-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2145184 | Leadership and Product Development | 2 SWS | Lecture / 🗣 | Ploch |

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

**Competence Certificate**
oral exam (approx. 20 min)

**Prerequisites**
It is not possible to combine this brick with brick Leadership and Management Development [T-MACH-112585].

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

## V Leadership and Product Development

2145184, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Overview of leadership theories and their application
Selected management instruments and their use in organizations
Communication and leadership
change management
Management development and MD programmes
Assessment centres and management audits
Teamwork, team development and team roles
Coaching as an instrument of modern leadership
Intercultural competence and cross-cultural leadership
Management and ethics, corporate governance
Practical exercises and examples to deepen selected contents

**Organizational issues**
Vorlesungsanmeldung und Informationen zur Veranstaltung werden im ILIAS Kurs zur Verfügung gestellt.
Weitere Information siehe IPEK-Homepage

**Literature**
Vorlesungsumdruck

# T 8.141 Course: Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113578]

**Responsible:** Dr. Christine Mielke
Christine Myglas
**Organisation:**
**Part of:** M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

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

**Competence Certificate**
Active participation, learning protocols, if applicable.

**Prerequisites**
None

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

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

**Recommendation**
It is recommended that you complete the lecture series "Science in Society" before attending events in the advanced module and in parallel with attending the basic seminar.
If it is not possible to attend the lecture series and the basic seminar in the same semester, the lecture series can also be attended after attending the basic seminar.
However, attending events in the advanced module before attending the lecture series should be avoided.

**Annotation**
The basic module consists of the lecture series "Science in Society" and the basic seminar. The lecture series is only offered during the summer semester.
The basic seminar can be attended in the summer or winter semester.

# T 8.142 Course: Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice [T-MACH-110954]

**Responsible:** Prof. Dr.-Ing. Luise Kärger
Dr.-Ing. Wilfried Liebig
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113110 | Lightweight constructions with fiber-reinforced-polymers – theory and practice | 4 SWS | Lecture / Practice ( / 🗣 | Kärger, Liebig |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-110954 | Lightweight constructions with fiber-reinforced-polymers – theory and practice | | | Liebig, Kärger |

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

**Competence Certificate**
oral exam (about 25 minutes)

**Prerequisites**
none

**Recommendation**

- Materials of Lightweight Construction
- Structural Analysis of Composite Laminates
- Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

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

## V Lightweight constructions with fiber-reinforced-polymers – theory and practice

**Lecture / Practice (VÜ) On-Site**

2113110, WS 24/25, 4 SWS, Language: German, Open in study portal

**Content**

The cooperative educational concept of the FAST-LB and IAM-WK give students an understanding of theory and practice for lightweight constructing with fiber-reinforced-polymers. Students solve an engineering lightweight task in small groups (max. 4 p.), for example the construction of an optimal bending beam under certain space and weight conditions. Various Materials (fibers, resins, foams, etc.) as well as relevant material data are provided and can be used any arbitrary combination. Mechanical properties of the semi-finished fiber products are to be determined by supervised tests on coupon samples. In a first step, students develop a theoretical solution and verify it simulative. Therefore, an introductory basic lecture teaches the mechanics and simulations techniques of fiber-reinforced-polymers. In a second step the students manufacture specimens based on their theoretical solution at the IAM-WK. The specimens are then tested on bending machines. The students gain knowledge about fiber-reinforced-polymers (materials, manufacturing, manufacturing effects, restrictions, etc.) and structural analysis simulations (modelling, simplifications, assumptions, material models, etc.) as well as material characterization and testing. Building on the basic lecture the knowledge is gained autonomously by solving realistic practice relevant tasks. The main topics are

- Fundamentals of lightweight strategies
- Basics of fiber-reinforced-polymers
- Basics of FEM simulation with anisotropic multi-material systems
- Independent development of suitable component concepts in teams of 4
- Independent development of simulation models for verification and design of own component concepts
- Calculation of anisotropic stiffness parameters from characterization tests
- Manufacturing of fiber-reinforced-polymers
- Mechanical testing

**Learning Objectives**

Students will be able to name and explain lightweight design strategies. They are familiar with typical fiber and matrix materials and their function in fiber composite materials. They will be familiar with the operating principle of a sandwich composite with foam core and will be able to describe and justify typical deformation and stress curves. They can name characteristic mechanical parameters and manufacturing processes. For the numerical analysis of FRP components, the students know simple laminate theories, they can set up a finite element model in Abaqus, select suitable finite elements, evaluate the simulation results and derive conclusions for improving the load-bearing effect. Students know the main steps and boundary conditions for manual fabrication and mechanical testing of fiber composite sandwich structures and can apply them in practice. They learn to work independently in teams on an open task, to elaborate the necessary boundary conditions and parameters and to obtain additional information where necessary.

# T 8.143 Course: Lightweight Engineering Design [T-MACH-105221]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2146190 | Lightweight Engineering Design | 2 SWS | Lecture / 🗣 | Düser, Ott |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105221 | Lightweight Engineering Design | | | Düser, Ott, Albers, Burkardt |
| WT 24/25 | 76-T-MACH-105221 | Lightweight Engineering Design | | | Albers, Burkardt |

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

**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 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
General aspects of leightweight design, lightweight strategies, construction methods, design principles, lightweight construction, stiffening techniques, lightweight materials, virtual product engineering, bionics, joining techniques, validation, recycling

Additionally, guest speakers from industry will present lightweight design from an practical point of view.

The students are able to ...

- evaluate the potential of central lightweight strategies and their application in design processes.
- apply different stiffing methods qualitatively and to evaluate their effectiveness.
- evaluate the potential of computer-aided engineering as well as the related limits and influences on manufacturing.
- reflect the basics of lightweight construction from a system view in the context of the product engineering process.

**Organizational issues**
Vorlesungsfolien können über die eLearning-Plattform ILIAS bezogen werden.

Die Prüfungsart wird gemäß der Prüfungsordnung zu Vorlesungsbeginn angekündigt:

- Schriftliche Prüfung: 90 min Prüfungsdauer
- Mündliche Prüfung: 20 min Prüfungsdauer
- Erlaubte Hilfsmittel: keine

Medien: Beamer

Arbeitsbelastung:

- Präsenzzeit: 21 h
- Selbststudium: 99 h

Lecture slides are available via eLearning-Platform ILIAS.

The type of examination (written or oral) will be announced at the beginning of the lecture:

- written examination: 90 min duration
- oral examination: 20 min duration
- auxiliary means: None

Media: Beamer

Workload:

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

**Literature**
Klein, B.: Leichtbau-Konstruktion. Vieweg & Sohn Verlag, 2007

Wiedemann, J.: Leichtbau: Elemente und Konstruktion, Springer Verlag, 2006

Harzheim, L.: Strukturoptimierung. Grundlagen und Anwendungen. Verlag Harri Deutsch, 2008

# T 8.144 Course: Machine Dynamics [T-MACH-105210]

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

**Part of:** M-MACH-102746 - Compulsory Elective Module
M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102820 - Major Field: Mechatronics
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104442 - Major Field: Vibration Theory

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2161224 | Machine Dynamics | 2 SWS | Lecture / | Proppe |
| ST 2024 | 2161225 | Machine Dynamics (Tutorial) | 1 SWS | Practice / | Proppe, Fischer |
| WT 24/25 | 2161224 | Machine Dynamics | 2 SWS | Lecture / | Proppe |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105210 | Machine Dynamics | | | Proppe |

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

**Competence Certificate**
written exam, 180 min.

**Prerequisites**
none

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

## V Machine Dynamics

2161224, SS 2024, 2 SWS, Language: German/English, Open in study portal

**Lecture (V)**
**On-Site**

**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

**Literature**
Biezeno, Grammel: Technische Dynamik, 2. Aufl., 1953

Holzweißig, Dresig: Lehrbuch der Maschinendynamik, 1979

Dresig, Vulfson: Dynamik der Mechanismen, 1989

## V Machine Dynamics (Tutorial)

2161225, SS 2024, 1 SWS, Language: English, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Exercises related to the lecture

## V Machine Dynamics

2161224, WS 24/25, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**Online**

**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

**Literature**
Biezeno, Grammel: Technische Dynamik, 2. Aufl., 1953

Holzweißig, Dresig: Lehrbuch der Maschinendynamik, 1979

Dresig, Vulfson: Dynamik der Mechanismen, 1989

# T 8.145 Course: Machine Dynamics II [T-MACH-105224]

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

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102820 - Major Field: Mechatronics
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104442 - Major Field: Vibration Theory

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162220 | Machine Dynamics II | 2 SWS | Lecture / | Proppe |
| WT 24/25 | 2162220 | Machine Dynamics II | 2 SWS | Lecture / | Proppe |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105224 | Machine Dynamics II | | | Proppe |

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

**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

2162220, SS 2024, 2 SWS, Language: German/English, Open in study portal

**Lecture (V)**
**Online**

**Content**
Students are able to develop and analyze detailed models in machine dynamics that encompass continuum models, fluid structure interaction, and stability analyses.

hydrodynamic bearings

• rotating shafts in hydrodynamic bearings

• belt drives

• virbation of turbine blades

**Literature**
R. Gasch, R. Nordmann, H. Pfützner: Rotordynamik, Springer, 2006

## V Machine Dynamics II

2162220, WS 24/25, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**Online**

**Content**
hydrodynamic bearings

• rotating shafts in hydrodynamic bearings

• belt drives

• virbation of turbine blades

**Organizational issues**
Die Vorlesung wird ausschließlich online angeboten.

**Literature**
R. Gasch, R. Nordmann, H. Pfützner: Rotordynamik, Springer, 2006

# T 8.146 Course: Machine Tools and High-Precision Manufacturing Systems [T-MACH-110962]

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

**Part of:** M-MACH-102589 - Major Field: Production Systems
M-MACH-102815 - Major Field: Engineering Design

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2149910 | Machine Tools and High-Precision Manufacturing Systems | 6 SWS | Lecture / Practice ( / 🗣 | Fleischer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-110962 | Machine Tools and High-Precision Manufacturing Systems | | | Fleischer |
| WT 24/25 | 76-T-MACH-110962 | Machine Tools and High-Precision Manufacturing Systems | | | Fleischer |

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

**Competence Certificate**
Oral exam (40 minutes)

**Prerequisites**
T-MACH-102158 - Machine Tools and Industrial Handling must not be commenced.
T-MACH-109055 - Machine Tools and Industrial Handling must not be commenced.
T-MACH-110963 - Machine Tools and High-Precision Manufacturing Systems must not be commenced.

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

## V Machine Tools and High-Precision Manufacturing Systems

2149910, WS 24/25, 6 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**
The lecture gives an overview of the construction, use and application of machine tools and high-precision manufacturing systems. In the course of the lecture a well-founded and practice-oriented knowledge for the selection, design and evaluation of machine tools and high-precision manufacturing systems is conveyed. First, the main components of the systems are systematically explained and their design principles as well as the integral system design are discussed. Subsequently, the use and application of machine tools and high-precision manufacturing systems 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 and artificial intelligence.
Guest lectures from industry round off the lecture with insights into practice.

The individual topics are:

- Structural components of dynamic manufacturing Systems
- Feed axes: High-precision positioning
- Spindles of cutting machine Tools
- Peripheral Equipment
- Machine control unit
- Metrological Evaluation
- Maintenance strategies and condition Monitoring
- Process Monitoring
- Development process for machine tools and high-precision manufacturing Systems
- Machine examples

**Learning Outcomes:**

The students …

- are able to assess the use and application of machine tools and high-precision manufacturing systems and to differentiate between them in terms of their characteristics and design.
- can describe and discuss the essential elements of machine tools and high-precision manufacturing systems (frame, main spindle, feed axes, peripheral equipment, control unit).
- are able to select and dimension the essential components of machine tools and high-precision manufacturing systems.
- are capable of selecting and evaluating machine tools and high-precision manufacturing systems according to technical and economic criteria.

**Workload:**

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

**Organizational issues**
Vorlesungstermine montags und mittwochs, Übungstermine donnerstags.
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

Lectures on Mondays and Wednesdays, tutorial on Thursdays.
The tutorial dates will announced in the first lecture.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

**Literature**
**Medien**:
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.147 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-102817 - Major Field: Information Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 8 | Grade to a third | Each winter term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2137308 | Machine Vision | 4 SWS | Lecture / Practice ( / | Lauer, Merkert |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105223 | Machine Vision | | | Stiller, Lauer |

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

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

**Lecture / Practice (VÜ)**
**On-Site**

**Content**
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.

Nachweis: written exam, 60 min.

Arbeitsaufwand: 240 hours

Voraussetzungen: none

**Literature**
Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt.Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.

# T 8.148 Course: Machines and Processes [T-MACH-105208]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
Prof. Dr. Thomas Koch
Dr.-Ing. Heiko Kubach
Dr. Balazs Pritz

**Organisation:** KIT Department of Mechanical Engineering

Institute of Thermal Turbomachinery

**Part of:** M-MACH-102566 - Machines and Processes

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 7 | Grade to a third | Each term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 3134140 | Machines and Processes | 4 SWS | Lecture / Practice ( / 🗣 | Bauer, Maas, Kubach, Pritz, Bykov |
| WT 24/25 | 2185000 | Machines and Processes | 4 SWS | Lecture / Practice ( / 🗣 | Bauer, Pritz, Koch |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105208 | Machines and Processes | | | Kubach, Bauer, Maas, Pritz, Bykov |
| ST 2024 | 76-T-MACH-105208e | Machines and Processes | | | Kubach, Bauer, Maas, Pritz, Bykov |
| ST 2024 | 76-T-MACH-105208e-NEW | Machines and Processes | | | Kubach, Bauer, Maas, Pritz, Bykov |
| ST 2024 | 76-T-MACH-105208-NEU | Machines and Processes | | | Kubach, Bauer, Maas, Pritz, Bykov |

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

**Competence Certificate**
written exam (duration: 120 min)

**Prerequisites**
Taking part at the exam is possible only when lab course has been successfully completed

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105232 - Machines and Processes, Prerequisite must have been passed.

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

V **Machines and Processes** — **Lecture / Practice (VÜ) On-Site**
2185000, WS 24/25, 4 SWS, Language: German, Open in study portal

**Content**

- Introduction to power engineering
- Radial and axial turbines
- Pumps
- Compressors
- Blowers
- Wind turbines
- Fuel cells
- Energy storage
- E-motors
- Heat pumps
- Combined heat and power
- Diesel engines
- Gasoline engines
- Hydrogen engines

# T 8.149 Course: Machines and Processes, Prerequisite [T-MACH-105232]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
Dr.-Ing. Heiko Kubach
Prof. Dr. Ulrich Maas
Dr. Balazs Pritz

**Organisation:** KIT Department of Mechanical Engineering

Institute of Thermal Turbomachinery

**Part of:** M-MACH-102566 - Machines and Processes

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 0 | pass/fail | Each term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2187000 | Machines and Processes (Lab Course) | 1 SWS | Practical course / 🗣 | Bauer, Kubach, Maas, Pritz, Bykov |
| WT 24/25 | 2187000 | Machines and Processes | 1 SWS | Practical course / 🗣 | Bauer, Kubach, Pritz, Schmidt, Bykov |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105232 | Machines and Processes, Prerequisite | | | Kubach, Bauer, Maas, Pritz, Bykov |

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

**Competence Certificate**
successful completed training course

**Prerequisites**
none

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

## V Machines and Processes (Lab Course)

2187000, SS 2024, 1 SWS, Language: German, Open in study portal

**Practical course (P)**
**On-Site**

**Content**
successful lab course and written exam (2 h)

Taking part at the exam is possible only when lab course has been successfully completed

Lab course and lecture take place in summer and winter semester.

In the SS the lecture is held in English. The lab course is always bilingual.

**Media:**

slides to download

Documentation of the labcourse

basics of thermodynamics

thermal fluid machines

- steam turbunes
- gas turbines
- combined-cycle plants
- turbines and compressors
- aircraft engines

hydraulic fluid machines

- oerating performance
- characterization
- control
- cavitation
- wind turbines, propellers

internal combustion engines

- characteristic parameters
- engine parts
- kinematics
- engine processes
- emissions

regular attendance: 48 h, self-study: 160 h

The students can name and describe basic energy conversion processes and energy converting machines. They can explain the application of these energy conversion processes in various machines. They can analyze and evaluate the processes and machines in terms of functionality and efficiency and they are able to solve basic technical problems in terms of operating the machines.

V **Machines and Processes** **Practical course (P)**
2187000, WS 24/25, 1 SWS, Open in study portal **On-Site**

**Content**
Lab Course Experiment

# T 8.150 Course: Manufacturing Technology [T-MACH-102105]

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

**Part of:** M-MACH-102589 - Major Field: Production Systems
M-MACH-102815 - Major Field: Engineering Design

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 8 | Grade to a third | Each winter term | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2149657 | Manufacturing Technology | 6 SWS | Lecture / Practice ( / | Schulze |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102105 | Manufacturing Technology | | | Schulze |
| WT 24/25 | 76-T-MACH-102105 | Manufacturing Technology | | | Schulze |

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

**Competence Certificate**
Written Exam (180 min)

**Prerequisites**
none

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

## V Manufacturing Technology

2149657, WS 24/25, 6 SWS, Language: German, Open in study portal

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

**Content**
The objective of the lecture is to look at manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to impart detailed process knowledge of the common processes. The lecture covers the basic principles of manufacturing technology and deals with the manufacturing processes according to their classification into main groups regarding technical and economic aspects. The lecture is completed with topics such as process chains in manufacturing.

The following topics will be covered:

- Quality control
- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming, plastics engineering)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment
- Process chains in manufacturing

This lucture provides an excursion to an industry company.

**Learning Outcomes:**

The students ...

- are capable to specify the different manufacturing processes and to explain their functions.
- are able to classify the manufacturing processes by their general structure and functionality according to the specific main groups.
- have the ability to perform a process selection based on their specific characteristics.
- are enabled to identify correlations between different processes and to select a process regarding possible applications.
- are qualified to evaluate different processes regarding specific applications based on technical and economic aspects.
- are experienced to classify manufacturing processes in a process chain and to evaluate their specific influence on surface integrity of workpieces regarding the entire process chain.

**Workload:**

regular attendance: 63 hours
self-study: 177 hours

**Organizational issues**
Vorlesungstermine montags und dienstags, Übungstermine mittwochs.
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

Die LV wird letztmalig im WS 2024/25 angeboten (Vorlesungsvideos bleiben online).

Die Prüfung wird für Erstschreiber letztmalig im SS 2025 und Wiederholer letztmalig im WS 2025/26 angeboten.

**Literature**
**Medien:**
Skript zur Veranstaltung wird über ilias (https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.151 Course: Materials Characterization [T-MACH-107684]

**Responsible:** Dr.-Ing. Jens Gibmeier
Prof. Dr. Reinhard Schneider
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2174586 | Materials Characterization | 2 SWS | Lecture / 🗣 | Gibmeier, Peterlechner |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-107684 | Materials Characterization | | | Gibmeier |
| WT 24/25 | 76-T-MACH-107684 | Materials Characterization | | | Gibmeier |

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

**Competence Certificate**
Oral exam, about 25 minutes

**Prerequisites**
Successful participation in Übungen zu Werkstoffanalytik is the condition for the admittance to the oral exam in Werkstoffanalytik.

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

T-MACH-110946 – Materials Characterization has not been started.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-107685 - Exercises for Materials Characterization must have been passed.

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

## V Materials Characterization

2174586, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

**learning objectives:**
The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure**.**

**Literature**
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

# T 8.152 Course: Materials of Lightweight Construction [T-MACH-105211]

**Responsible:** Dr.-Ing. Wilfried Liebig
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2174574 | Materials of Lightweight Construction | 2 SWS | Lecture / 🗣 | Liebig |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105211 | Materials of Lightweight Construction | | | Liebig |
| WT 24/25 | 76-T-MACH-105211 | Materials of Lightweight Construction | | | Liebig |

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

**Competence Certificate**
Oral exam, about 25 minutes

**Prerequisites**
none

**Recommendation**
Materials Science I/II

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

## V Materials of Lightweight Construction

2174574, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Introduction

Constructive, production-orientied and material aspects of lightweight construction

Aluminium-based alloys

Aluminium wrought alloys

Aluminium cast alloys

Magnesium-based alloys

Magnesium wrought alloys

Magnesium cast alloys

Titanium-based alloys

Titanium wrought alloys

Titanium cast alloys

High-strength steels

High-strength structural steels,

Heat-treatable steels, press-hardening and hardenable steels

Composites - mainly PMC

Matrices

Reinforcements

Basic mechanical principles of composites

Hybrid composites

Special materials for lightweight design

Beryllium alloys

Metallic Glasses

Applications

**learning objectives:**
The students are capable to name different lightweight materials and can describe their composition, properties and fields of application. They can describe the hardening mechanisms of lightweight materials and can transfer this knowledge to applied problems.
The students can apply basic mechanical models of composites and can depict differences in the mechanical properties depending on composition and structure. The students can describe the basic principle of hybrid material concepts and can judge their advantages in comparison to bulk materials. The students can name special materials for lightweight design and depict differences to conventional materials. The students have the ability to present applications for different lightweight materials and can balance reasons for their use.
**requirements:**
Werkstoffkunde I/II (recommended)
**workload:**

The workload for the lecture “Materials for Lightweight Construction” is 120 h per semester and consists of the presence during the lectures (24 h), preparation and rework time at home (48 h) and preparation time for the oral exam (48 h).

**Examination:**

Oral examination, Duration approx. 25 min

**Literature**
Literaturhinweise, Unterlagen und Teilmanuskript in der Vorlesung

# T 8.153 Course: Materials Recycling and Sustainability [T-MACH-110937]

**Responsible:** Dr.-Ing. Wilfried Liebig
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2173520 | Materials Recycling and Sustainability | 2 SWS | Lecture / 🗣 | Liebig |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-110937 | Materials Recycling and Sustainability | | | Liebig |
| WT 24/25 | 76-T-MACH-110937 | Materials Recycling and Sustainability | | | Liebig |

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

**Competence Certificate**
oral exam (about 25 min.)

**Prerequisites**
none

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

## V Materials Recycling and Sustainability

2173520, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
The lecture series is organised in two main topics: On the one hand, fundamentals of sustainability are explained and it is shown how to tread more sustainable paths in materials science and mechanical engineering. On the other hand, separation and recycling processes for all common classes of materials are presented and discussed. It is shown how recycling fosters a holistic and sustainable perspective on material processing and use.

1. legal bases and historical background
2. climate change, ecology and material flows
3. sustainability in general
4. product responsibility, recyclable design and planned obsolescence
5. general and legal bases of recycling
6. material separation, sorting and processing
7. recycling of metals
8. recycling of polymers and composites
9. recycling of everyday materials
10. alternative materials and alternative design concepts
11. materials for renewable energy sources

**Literature**
Skript wird in der Vorlesung ausgegeben

# T 8.154 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-102819 - Major Field: Materials Science and Engineering

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 8 | Grade to a third | Each winter term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2173553 | Materials Science and Engineering III | 4 SWS | Lecture / 🗣 | Heilmaier, Guth |
| WT 24/25 | 2173554 | Exercises in Materials Science and Engineering III | 1 SWS | Practice / 🗣 | Heilmaier, Kauffmann |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105301 | Materials Science III | | | Heilmaier, Guth |
| WT 24/25 | 76-T-MACH-105301 | Materials Science III | | | Heilmaier, Guth |

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

**Competence Certificate**
Oral exam, about 35 minutes

**Prerequisites**
T-MACH-110818 - Plasticity of Metals and Intermetallics has not been started

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

## V Materials Science and Engineering III

2173553, WS 24/25, 4 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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.

**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

**Literature**
Vorlesungsskript; Übungsaufgaben; Bhadeshia, H.K.D.H. & Honeycombe, R.W.K.
Steels – Microstructure and Properties
CIMA Publishing, 3. Auflage, 2006

# T 8.155 Course: Materials Science I & II [T-MACH-105145]

**Responsible:** Dr.-Ing. Jens Gibmeier
Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr. Astrid Pundt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102562 - Materials Science

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 11 | Grade to a third | Each winter term | 2 |

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2174560 | Materials Science and Engineering II for mach, phys | 3 SWS | Lecture / 🗣 | Heilmaier, Pundt |
| ST 2024 | 2174563 | Exercises in Materials Science and Engineering II for mach, phys | 1 SWS | Practice / 🗣 | Heilmaier, Kauffmann |
| ST 2024 | 3174015 | Materials Science and Engineering II (Lecture) | 3 SWS | Lecture / 🗣 | Gibmeier |
| ST 2024 | 3174026 | Materials Science and Engineering II (Tutorials) | 1 SWS | Practice / 🗣 | Gibmeier, Mitarbeiter |
| WT 24/25 | 2173550 | Materials Science and Engineering I for mach, phys | 4 SWS | Lecture / 🗣 | Pundt, Kauffmann |
| WT 24/25 | 2173552 | Exercises in Materials Science and Engineering I for mach, phys | 1 SWS | Practice / 🗣 | Pundt, Kauffmann |
| WT 24/25 | 3173008 | Materials Science and Engineering I (Lecture) | 4 SWS | Lecture / 🗣 | Gibmeier |
| WT 24/25 | 3173009 | Materials Science and Engineering I (Tutorial) | 1 SWS | Practice / 🗣 | Gibmeier |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105145 | Materials Science I, II | | | Heilmaier, Pundt |
| ST 2024 | 76-T-MACH-105145-English | Materials Science I & II (Exam in English) | | | Heilmaier, Gibmeier |
| WT 24/25 | 76-T-MACH-105145 | Materials Science I, II | | | Heilmaier, Pundt |
| WT 24/25 | 76-T-MACH-105145-English | Materials Science I & II | | | Heilmaier, Pundt, Gibmeier |

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

**Competence Certificate**
oral exam, about 25 minutes

**Prerequisites**
Lab course must be finished successfully prior to the registration for the oral exam.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105146 - Materials Science Lab Course must have been passed.

**Annotation**
The workload for the lecture Materials Science I & II is 165 h per semester and consists of the presence during the lectures (WS: 4 SWS, SS: 2SWS) and the exercises (1 SWS per WS and 1 SWS per SS) as well as preparation and rework time at home.

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

## V Materials Science and Engineering II for mach, phys

**Lecture (V)**
**On-Site**

2174560, SS 2024, 3 SWS, Language: German, Open in study portal

**Content**
**Topics:**

Ferrous materials

Non-ferrous metals and alloys

Engineering ceramics

Glasses

Polymers

Composites

**Learning Objectives:**

The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can name representative materials for different material classes and can describe the differences.

The students are able to describe the basic mechanisms of hardening for ferrous and non-ferrous materials and reflect these mechanisms using phase and TTT diagrams.

The students can interpret given phase, TTT or other diagrams relevant for materials science, gather information from them and can correlate them regarding the microstructure evolution.

The students can describe the phenomena correlated with materials science in polymers, metals and ceramics and depict differences.

The students know about standard materials characterization methods and are able to asses materials on base of the data obtained by these methods.

**Requirements:**
Materials Science and Engineering I

**Workload:**

regular attendance: 42 hours
self-study: 108 hours

**Examination:**

Combined with 'Materials Science and Engineering I'; oral; about 30 minutes

The successful partcipation in the lab course is obligatory for the admission to the examination.

**Organizational issues**
Weitere Informationen zu dieser Veranstaltung finden Sie hier: https://www.iam.kit.edu/wk/lehre.php

**Literature**
Vorlesungsskript, Vorlesungsvideos, Übungsblätter, Übungsvideos

Weiterführende Informationen gibt es hier:

J. F. Shackelford: „Werkstofftechnologie für Ingenieure. Grundlagen - Prozesse - Anwendungen“, Pearson Studium (2005)
https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC117341509

A. Rösler, H. Harders, M. Bäker: „Mechanisches Verhalten der Werkstoffe“, Springer Vieweg (2016)
http://dx.doi.org/10.1007/978-3-658-13795-3 (frei im KIT-Netz erhältlich)

G. Gottstein: „Materialwissenschaft und Werkstofftechnik: Physikalische Grundlagen“, Springer (2014)
http://dx.doi.org/10.1007/978-3-642-36603-1 (frei im KIT-Netz erhältlich)

J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
https://www.ifw-dresden.de/de/ifw-institutes/ikm/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften (frei zugänglich)

## V Exercises in Materials Science and Engineering II for mach, phys

**Practice (Ü)**
**On-Site**

2174563, SS 2024, 1 SWS, Language: German, Open in study portal

**Content**
**Learning Objectives:**

The students can apply the knowledge gained through the lacture as well as self-studies and transfer this knowledge to problems given.

They can carry out calculations independantly dealing with different subjects of materials science. Therefore, they are able to decide which formulas allow the calculation based on the question given.

Theyare able to discuss aspects of materials science both quantitatively and qualitatively and can present these results oraly.

**Requirements:**
Lecture on Materials Science and Engineering II

**Organizational issues**
Weitere Informationen finden Sie hier: https://www.iam.kit.edu/wk/lehre.php

**Literature**
Vorlesungsskript, Vorlesungsvideos, Übungsblätter, Übungsvideos

Weiterführende Informationen gibt es hier:

J. F. Shackelford: „Werkstofftechnologie für Ingenieure. Grundlagen - Prozesse - Anwendungen“, Pearson Studium (2005)
https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC117341509

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)

**V** **Materials Science and Engineering II (Lecture)** **Lecture (V)**
3174015, SS 2024, 3 SWS, Language: English, Open in study portal **On-Site**

**Content**

Ferrous materials

Non-ferrous metals and alloys

Engineering ceramics

Glasses

Polymers

Composites

**learning objectives:**

The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can name representative materials for different material classes and can describe the differences.

The students are able to describe the basic mechanisms of hardening for ferrous and non-ferrous materials and reflect these mechanisms using phase and TTT diagrams.

The students can interpret given phase, TTT or other diagrams relevant for materials science, gather information from them and can correlate them regarding the microstructure evolution.

The students can describe the phenomena correlated with materials science in polymers, metals and ceramics and depict differences.

The students know about standard materials characterization methods and are able to asses materials on base of the data obtained by these methods.

**requirements:**
Materials Science and Engineering I
**workload:**

regular attendance: 42 hours
self-study: 108 hours

**examination:**

Combined with 'Materials Science and Engineering I'; oral; about 30 minutes

The successful partcipation in the lab course is obligatory for the admission to the examination.

**Literature**
Vorlesungsskript; Übungsaufgabenblätter;

Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005

## V Materials Science and Engineering II (Tutorials)

3174026, SS 2024, 1 SWS, Language: English, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Examplary calculations

**learning objectives:**

The students can apply the knowledge gained through the lacture as well as self-studies and transfer this knowledge to problems given.

They can carry out calculations independantly dealing with different subjects of materials science. Therefore, they are able to decide which formulas allow the calculation based on the question given.

Theyare able to discuss aspects of materials science both quantitatively and qualitatively and can present these results oraly.

**requirements:**
Lecture Materials Science and Engineering II
**workload:**

**Literature**
see lecture notes

## V Materials Science and Engineering I for mach, phys

2173550, WS 24/25, 4 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Atomic structure and atomic bonds

Structures of crystalline solids

Defects in crystalline solids

Structure of amorphous and semi-crystalline solids

Alloys

Transport and transformation phenomena in the solid state

Microscopy methods

Characterization by means of X-rays, Neutrons and Electrons

Nondestructive testing of materials

Mechanical testing of materials

**learning objectives:**
The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can describe the typical property profies and can name applications for the most important engineering materials.

The students are able to describe standard materials characterization methods and can explain the evaluation of these methods. They can judge materials on base of the data obtained by these methods.

**requirements:**

None, **Recommendations:** None.

**workload:**

regular attendance: 53 hours
self-study: 157 hours

**Literature**
Vorlesungsskript; Videos, Übungsaufgabenblätter.

Shackelford, J.F., Werkstofftechnologie für Ingenieure,Verlag Pearson Studium, 2005

Skolaut, W., Maschinenbau (Ein Lehrbuch für das ganze Bachelor-Studium), Springer, Heidelberg 2014

Gottstein, G., Physikalische Grundlagen der Materialkunde, 3 Aufl., Springer Verlag, Berlin, 2007

## V Exercises in Materials Science and Engineering I for mach, phys

2173552, WS 24/25, 1 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Example exercises

**learning objectives:**

The students can apply the knowledge gained through the lacture as well as self-studies and transfer this knowledge to problems given.

They can carry out calculations independantly dealing with different subjects of materials science. Therefore, they are able to decide which formulas allow the calculation based on the question given.

Theyare able to discuss aspects of materials science both quantitatively and qualitatively and can present these results oraly.

**requirements:**
Lecture Materials Science and Engineering I

**workload:**

Regular attendance: 21 h, self studies: 21 h

**Literature**
Vorlesungsskript zu WK1

## V Materials Science and Engineering I (Lecture)

3173008, WS 24/25, 4 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

Ferrous materials

Non-ferrous metals and alloys

Engineering ceramics

Glasses

Polymers

Composites

**learning objectives:**

The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can name representative materials for different material classes and can describe the differences.

The students are able to describe the basic mechanisms of hardening for ferrous and non-ferrous materials and reflect these mechanisms using phase and TTT diagrams.

The students can interpret given phase, TTT or other diagrams relevant for materials science, gather information from them and can correlate them regarding the microstructure evolution.

The students can describe the phenomena correlated with materials science in polymers, metals and ceramics and depict differences.

The students know about standard materials characterization methods and are able to asses materials on base of the data obtained by these methods.

**requirements:**
Materials Science and Engineering I
**workload:**

regular attendance: 42 hours
self-study: 108 hours

**examination:**

Combined with 'Materials Science and Engineering I'; oral; about 30 minutes

The successful partcipation in the lab course is obligatory for the admission to the examination.

**Literature**
Vorlesungsskript; Übungsaufgabenblätter;

Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005

## V Materials Science and Engineering I (Tutorial)

3173009, WS 24/25, 1 SWS, Language: English, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Examplary calculations

**learning objectives:**

The students can apply the knowledge gained through the lacture as well as self-studies and transfer this knowledge to problems given.

They can carry out calculations independantly dealing with different subjects of materials science. Therefore, they are able to decide which formulas allow the calculation based on the question given.

Theyare able to discuss aspects of materials science both quantitatively and qualitatively and can present these results oraly.

**requirements:**
Lecture Materials Science and Engineering II
**workload:**

**Literature**
see lecture notes

# T 8.156 Course: Materials Science Lab Course [T-MACH-105146]

**Responsible:** Dr.-Ing. Jens Gibmeier
Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr. Astrid Pundt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102562 - Materials Science

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (practical) | 3 | pass/fail | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2174597 | Experimental Lab Course in Material Science | 3 SWS | Practical course / 🗣 | Wagner, Heilmaier, Pundt, Dietrich, Guth |
| ST 2024 | 3174016 | Materials Science and Engineering Lab Course | 3 SWS | Practical course / 🗣 | Gibmeier, Heilmaier, Pundt |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105146 | Materials Science, Lab Course | | | Heilmaier, Pundt |

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

**Competence Certificate**
Oral colloquium at the beginning of each topic; certificate of successful attendance.

**Prerequisites**
none

**Annotation**
The workload for the lab course Materials Science is 90 h in total and consists of the presence during the 10 experiments (one week half-time, 4 hours per day) as well as preparation and rework time at home.

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

## V Experimental Lab Course in Material Science

2174597, SS 2024, 3 SWS, Language: German, Open in study portal

**Practical course (P)**
**On-Site**

**Content**
Performing and evaluating of laboratory experiments in the following topics:

Mechanical testing of materials
Nonmetallic materials
Microstructure and properties
Cyclic loading / fatigue
Influence of manufacturing technique on materials

**learning objectives:**

The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can name standard materials characterization methods and can describe the execution of the tests as well as the evaluation of the results. The students are able to asses materials on base of the data obtained by these methods.

The students are capable to select appropriate experiments to clarify probelms regarding the materials behaviour. They can describe the experimental procedures and can carry out experiments. They can derive material properties from data gained in experiments. They can interpret these properties regarding microstructure-propety-relations.

**requirements:**
Materials Science and Engineering I & II
**workload:**

regular attendance: 22 hours
self-study: 68 hours

**Organizational issues**
Blockveranstaltung. Infos durch ILIAS und in der VL WK II. Anmeldung erforderlich.

**Literature**
Praktikumsskriptum

Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005

V

## Materials Science and Engineering Lab Course

**Practical course (P)**
**On-Site**

3174016, SS 2024, 3 SWS, Language: English, Open in study portal

**Content**
Performing and evaluating of laboratory experiments in the following topics:

Mechanical testing of materials
Nonmetallic materials
Microstructure and properties
Cyclic loading / fatigue
Influence of manufacturing technique on materials

**learning objectives:**

The students are able to describe the relationship between atomic structure, microscopical observations, and properties of solid materials.

The students can name standard materials characterization methods and can describe the execution of the tests as well as the evaluation of the results. The students are able to asses materials on base of the data obtained by these methods.

The students are capable to select appropriate experiments to clarify probelms regarding the materials behaviour. They can describe the experimental procedures and can carry out experiments. They can derive material properties from data gained in experiments. They can interpret these properties regarding microstructure-propety-relations.

**requirements:**
Materials Science and Engineering I & II
**workload:**

regular attendance: 22 hours
self-study: 68 hours

**Organizational issues**
Registration required. Note announcements (MSE lecture and ILIAS)

**Literature**
Praktikumsskriptum

Shackelford, J.F.
Werkstofftechnologie für Ingenieure
Verlag Pearson Studium, 2005

# T 8.157 Course: Mathematical Methods in Continuum Mechanics [T-MACH-110836]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke
**Organisation:**
**Part of:** M-MACH-102582 - Major Field: Continuum Mechanics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2161254 | Mathematical Methods in Continuum Mechanics | 2 SWS | Lecture / 🗣 | Böhlke |

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

**Competence Certificate**
written exam (90 min). Additives as announced.

There are no prerequisites within the Major Field 13 (Continuum Mechanics)

**Annotation**
This brick can only be chosen within Major Field 13 of Bachelor studies Mechanical Engineering. There are no prerequisites for the exam.

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

## V Mathematical Methods in Continuum Mechanics

**Lecture (V)**
**On-Site**

2161254, WS 24/25, 2 SWS, Language: German, Open in study portal

**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

**Literature**
Vorlesungsskript
Liu, I-S.: Continuum Mechanics. Springer, 2002.
Greve, R.: Kontinuumsmechanik, Springer 2003
Schade, H.: Tensoranalysis.Walter de Gruyter, New York, 1997.
Schade, H: Strömungslehre, de Gruyter 2013

# T 8.158 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-102746 - Compulsory Elective Module

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2161254 | Mathematical Methods in Continuum Mechanics | 2 SWS | Lecture / 🗣 | Böhlke |

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

**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

2161254, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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

**Literature**
Vorlesungsskript
Liu, I-S.: Continuum Mechanics. Springer, 2002.
Greve, R.: Kontinuumsmechanik, Springer 2003
Schade, H.: Tensoranalysis.Walter de Gruyter, New York, 1997.
Schade, H: Strömungslehre, de Gruyter 2013

# T 8.159 Course: Mathematical Methods in Dynamics [T-MACH-105293]

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

**Part of:** M-MACH-102746 - Compulsory Elective Module
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2161206 | Mathematical Methods in Dynamics | 2 SWS | Lecture / | Proppe |
| WT 24/25 | 2161206 | Mathematical Methods in Dynamics | 2 SWS | Lecture / | Proppe |
| WT 24/25 | 2161207 | Übungen zu Mathematische Methoden der Dynamik | 1 SWS | Practice / | Proppe, Luo |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105293 | Mathematical Methods in Dynamics | | | Proppe |

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

**Competence Certificate**
written examination, 180 min.

**Prerequisites**
none

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

## V Mathematical Methods in Dynamics

2161206, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Online**

**Content**
The students know precisely the mathematical methods of dynamics. They are able to use the basic mathematical methods for modelling the dynamical behaviour of elastic and rigid bodies. The students also have a basic understanding of the description of kinematics and kinetics of bodies. They also master the alternative fomulations based on weak formulations and variational methods and the approximate solution methods for numerical calculations of the moving behaviour of elastic bodies.

Dynamics of continua:
Concept of continuum, geometry of continua, kinematics and kinetics of continua

Variational principles:
Priniciple of virtual work, variational calculations, Principle of Hamilto

Approximate solution methods:
Methods of weighted residuals, method of Ritz

**Literature**
Vorlesungsskript (erhältlich im Internet)

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

## Mathematical Methods in Dynamics

2161206, WS 24/25, 2 SWS, Language: German, Open in study portal

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

**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

**Literature**
Vorlesungsskript (erhältlich im Internet)

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

2161207, WS 24/25, 1 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Excercises related to the lecture

# T 8.160 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-102746 - Compulsory Elective Module

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 6 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2154432 | Mathematical Methods in Fluid Mechanics | 4 SWS | Lecture / Practice ( / | Gatti, Frohnapfel |
| ST 2024 | 2154540 | Mathematical Methods in Fluid Mechanics | 4 SWS | Lecture / Practice ( / | Gatti, Frohnapfel |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105295 | Mathematical Methods in Fluid Mechanics | | | Frohnapfel, Gatti |
| ST 2024 | 76-T-MACH-105295 (engl.) | Mathematical Methods in Fluid Mechanics | | | Gatti, Frohnapfel |

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

**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

2154432, SS 2024, 4 SWS, Language: German/English, Open in study portal

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

**Content**
The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical methods in fluid mechanics effectively in order to solve the resulting governing equations analytically, if possible, or to enable simpler numerical solution of the problem. The students 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:

- Creeping flows (Stokes flow)
- Lubrication theory
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows

**Organizational issues**
Die Vorlesung wird im SS2024 nur auf Englisch gehalten. Die Übungen werden in Deutsch und Englisch angeboten. Die Räume bleiben.

**Literature**

Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Kuhlmann, H.: Strömungsmechanik, Pearson, 2007

Spurk, J. H.: Strömungslehre, Springer, 2006

Zierep, J., Bühler, K.: Strömungsmechanik, Springer, 1991

Schlichting H., Gersten K., Grenzschichttheorie, Springer, 2006

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 Mathematical Methods in Fluid Mechanics

2154540, SS 2024, 4 SWS, Language: English, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**

The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical methods in fluid mechanics effectively in order to solve the resulting governing equations analytically, if possible, or to enable simpler numerical solution of the problem. The students 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:

- Creeping flows (Stokes flow)
- Lubrication theory
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows

**Literature**

Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Kuhlmann, H.: Strömungsmechanik, Pearson, 2007

Spurk, J. H.: Strömungslehre, Springer, 2006

Zierep, J., Bühler, K.: Strömungsmechanik, Springer, 1991

Schlichting H., Gersten K., Grenzschichttheorie, Springer, 2006

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

# T 8.161 Course: Mathematical Methods of Vibration Theory [T-MACH-105294]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin
Elke Höllig
Dr.-Ing. Ulrich Römer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102746 - Compulsory Elective Module
M-MACH-102820 - Major Field: Mechatronics
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104442 - Major Field: Vibration Theory

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162241 | Mathematical methods of vibration theory | 2 SWS | Lecture / ✕ | Römer |
| ST 2024 | 2162242 | Mathematical methods of vibration theory (Tutorial) | 2 SWS | Practice / ✕ | Keller, Römer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105294 | Mathematical Methods of Vibration Theory | | | Fidlin |

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

**Competence Certificate**
written examination, 180 min.

**Prerequisites**
none

**Recommendation**
Engineering Mechanics III/IV

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

## V Mathematical methods of vibration theory

2162241, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Cancelled**

**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

**Organizational issues**
Die Vorlesung Mathematische Methoden der Schwingungslehre wird im Sommersemester 2024 nicht angeboten.

**Literature**
Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

## V Mathematical methods of vibration theory (Tutorial)

2162242, SS 2024, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**Cancelled**

**Content**
Seven tutorials with examples of the contents of the course

**Organizational issues**
Die Vorlesung und Übungen zu Mathematische Methoden der Schwingungslehre werden im Sommersemester 2024 nicht angeboten.

**Literature**
Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

# T 8.162 Course: Measurement II [T-MACH-105335]

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

**Part of:** M-MACH-102817 - Major Field: Information Technology
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2138326 | Measurement II | 2 SWS | Lecture / 🗣 | Stiller, Steiner |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105335 | Measurement II | | | Stiller |

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

**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 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
**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.

**Nachweis:**

Written exam

60 minutes

Individual sheet of formulas

**Arbeitsaufwand:**

120 hours

**Literature**
Skript und Foliensatz zur Veranstaltung werden als kostenlose pdf-Dateien bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.

Idealerweise haben Sie zuvor 'Grundlagen der Mess- und Regelungstechnik' gehört oder verfügen aus einer Vorlesung anderer Fakultäten über grundlegende Kenntnisse der Mess- und Regelungstechnik und der Systemtheorie.

# T 8.163 Course: Mechanical Design I and II [T-MACH-105286]

**Responsible:** Prof. Dr.-Ing. Sven Matthiesen
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102573 - Mechanical Design

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 3146017 | Mechanical Design II Lecture | 2 SWS | Lecture / 🗣 | Düser, Burkardt |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105286 | Mechanical Design I & II | | | Albers, Matthiesen, Düser |
| ST 2024 | 76T-MACH-105286_EN | Mechanical Design I & II (english) | | | Albers, Matthiesen, Düser |
| WT 24/25 | 76-T-MACH-105286 | Mechanical Design I und II | | | Matthiesen, Düser |
| WT 24/25 | 76T-MACH-105286_EN | Mechanical Design I and II (english) | | | Burkardt |

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

**Competence Certificate**
written exam, graded, duration: 90 min

**Prerequisites**
Admission to the exam only with successful completion of the T-MACH-105282 - Mechanical Design I, prerequisites and T-MACH-105283 - Mechanical Design II, prerequisites.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105282 - Mechanical Design I, Prerequisites must have been passed.
2. The course T-MACH-105283 - Mechanical Design II, Prerequisites must have been passed.

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

## V Mechanical Design II Lecture

3146017, SS 2024, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Bearings

Sealings

Design

Bolted Connections

Tutorials take place in concomitant to the lectures.

**Prerequisites**

See preliminary workshops.

Further information's will be announced at Ilias and at the beginning of the lecture mechanical design II.

**Organizational issues**
Place of lecture (Lecture Room/Online) will be communicated on ILIAS

**Literature**

**Konstruktionselemente des Maschinenbaus -** 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-22033-X

oder Volltextzugriff über Uni-Katalog der Universitätsbibliothek

**Grundlagen von Maschinenelementen für Antriebsaufgaben**;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8 )

# T 8.164 Course: Mechanical Design I, Prerequisites [T-MACH-105282]

**Responsible:** Prof. Dr.-Ing. Sven Matthiesen
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102573 - Mechanical Design

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

**Competence Certificate**
Concomitant to the lecture, a workshop with 3 workshop sessions takes place over the semester. During the workshop the students are divided into groups and their mechanical design knowledge will be tested during a colloquium at the beginning of every single workshop session. The attendance is mandatory and will be controlled. The pass of the colloquia and the process of the workshop task are required for the successful participation.

Furthermore an online test is carried out.

**Prerequisites**
none

# T 8.165 Course: Mechanical Design II, Prerequisites [T-MACH-105283]

**Responsible:** Prof. Dr.-Ing. Sven Matthiesen
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102573 - Mechanical Design

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 1 | pass/fail | Each summer term | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 3146018 | Mechanical Design II Tutorials | 2 SWS | Practice / 🖥 | Düser, Burkardt |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105283 | Mechanical Design II | | | Matthiesen, Düser |

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

**Competence Certificate**
Successful completion of a design task is required to pass the prerequisite.

**Prerequisites**
None

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

## V Mechanical Design II Tutorials

3146018, SS 2024, 2 SWS, Language: English, Open in study portal

**Practice (Ü)**
**Online**

**Content**
Bearings

Sealings

Design

Bolted Connections

**Organizational issues**
Place of lecture (Lecture Room/Online) will be communicated on ILIAS

**Literature**
**Konstruktionselemente des Maschinenbaus -** 1 und 2
Grundlagen der Berechnung und Gestaltung von
Maschinenelementen;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-22033-X

**Grundlagen von Maschinenelementen für Antriebsaufgaben**;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

**CAD:**

3D-Konstruktion mit Pro/Engineer - Wildfire, Paul Wyndorps, Europa Lehrmittel, ISBN: 978-3-8085-8948-9

Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)

# T 8.166 Course: Mechanical Design III and IV [T-MACH-104810]

**Responsible:** Prof. Dr.-Ing. Sven Matthiesen
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102573 - Mechanical Design

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 11 | Grade to a third | Each term | 3 |

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2146177 | Mechanical Design IV | 2 SWS | Lecture / 🗣 | Matthiesen, Düser |
| ST 2024 | 3146020 | Mechanical Design IV Lecture | 2 SWS | Lecture / 🗣 | Düser, Burkardt |
| WT 24/25 | 3145016 | Mechanical Design III (Lecture) | 2 SWS | Lecture / 🗣 | Burkardt, Düser |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-104810 | Mechanical Design III & IV | | | Albers, Matthiesen, Düser |
| ST 2024 | 76-T-MACH-104810_EN | Mechanical Design III & IV (english) | | | Albers, Matthiesen, Düser |
| WT 24/25 | 76-T-MACH-104810 | Mechanical Design III & IV | | | Albers, Matthiesen, Düser, Burkardt |
| WT 24/25 | 76T-MACH-104810_EN | Mechanical Design III & IV (english) | | | Albers, Burkardt |

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

**Competence Certificate**
written exam consisting of:

- written part duration 60 min and
- design part duration 180 min

Sum: 240 min

**Prerequisites**
Admission to the exam only with successful completion of the Mechanical Design III, Tutorial and Mechanical Design IV, Tutorial.

**Modeled Conditions**
You have to fulfill one of 2 conditions:

1. The course T-MACH-110955 - Mechanical Design III, Tutorial must have been passed.
2. The course T-MACH-110956 - Mechanical Design IV, Tutorial must have been passed.

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

## V Mechanical Design III (Lecture)

3145016, WS 24/25, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Literature**
**Vorlesungsumdruck:**

Der Umdruck zur Vorlesung kann über die eLearning-Plattform Ilias bezogen werden.

**Literatur:**

**Konstruktionselemente des Maschinenbaus -** 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-22033-X

oder Volltextzugriff über Uni-Katalog der Universitätsbibliothek

Grundlagen von Maschinenelementen für Antriebsaufgaben;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

**CAD:**

3D-Konstruktion mit Pro/Engineer - Wildfire, Paul Wyndorps, Europa Lehrmittel, ISBN: 978-3-8085-8948-9

Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)

# T 8.167 Course: Mechanical Design III, Tutorial [T-MACH-110955]

**Responsible:** Prof. Dr.-Ing. Sven Matthiesen
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102573 - Mechanical Design

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2145154 | Mechanical Design III Workshop | 1 SWS | Practical course / 🗣 | Matthiesen, Düser |
| WT 24/25 | 3145017 | Mechanical Design III (Tutorial) | 2 SWS | Practice / 🗣 | Burkardt, Düser |
| WT 24/25 | 3145018 | Mechanical Design III (Workshop) | 1 SWS | / 🗣 | Burkardt, Düser |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105284 | Mechanical Design III,Tutorial | | | Albers, Matthiesen, Düser |

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

**Competence Certificate**
Concomitant to the lecture, a workshop with 3 workshop sessions takes place over the semester. During the workshop the students are divided into groups and their mechanical design knowledge will be tested during a colloquium at the beginning of every single CAD-workshop session. The attendance is mandatory and will be controlled. The pass of the colloquia and the process of the workshop task are required for the successful participation.

**Prerequisites**
None

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

## V Mechanical Design III Workshop

2145154, WS 24/25, 1 SWS, Language: German, Open in study portal

**Practical course (P)**
**On-Site**

**Organizational issues**
Anmeldung erforderlich; Termine & Ort siehe Ilias-Kurs/ IPEK-Homepage

Anmeldelink: https://portal.wiwi.kit.edu/ys/8237

**Literature**
**Konstruktionselemente des Maschinenbaus -** 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-22033-X

**Grundlagen von Maschinenelementen für Antriebsaufgaben**;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

**CAD:**

3D-Konstruktion mit Pro/Engineer - Wildfire, Paul Wyndorps, Europa Lehrmittel, ISBN: 978-3-8085-8948-9

Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)

## V Mechanical Design III (Tutorial)

3145017, WS 24/25, 2 SWS, Language: English, Open in study portal

**Practice (Ü)**
**On-Site**

**Literature**
**Konstruktionselemente des Maschinenbaus -** 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-22033-X

**Grundlagen von Maschinenelementen für Antriebsaufgaben**;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

**CAD:**

3D-Konstruktion mit Pro/Engineer - Wildfire, Paul Wyndorps, Europa Lehrmittel, ISBN: 978-3-8085-8948-9

Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)

V

## Mechanical Design III (Workshop)

3145018, WS 24/25, 1 SWS, Language: English, Open in study portal

**On-Site**

**Organizational issues**
Anmeldung erforderlich; Termine & Ort siehe Ilias-Kurs/ IPEK-Homepage

Anmeldelink: https://portal.wiwi.kit.edu/ys/8255

**Literature**
**Konstruktionselemente des Maschinenbaus -** 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-22033-X

**Grundlagen von Maschinenelementen für Antriebsaufgaben**;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

**CAD:**

3D-Konstruktion mit Pro/Engineer - Wildfire, Paul Wyndorps, Europa Lehrmittel, ISBN: 978-3-8085-8948-9

Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)

# T 8.168 Course: Mechanical Design IV, Tutorial [T-MACH-110956]

**Responsible:** Prof. Dr.-Ing. Sven Matthiesen
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102573 - Mechanical Design

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2146184 | Tutorials Mechanical Design IV | 1 SWS | Practice / 🗣 | Matthiesen, Düser |
| ST 2024 | 2146187 | Workshop 'Mechanical Design IV' | 1 SWS | / 🗣 | Matthiesen, Düser |
| ST 2024 | 3146021 | Mechanical Design IV Tutorials | 1 SWS | Practice / 💻 | Düser, Burkardt |
| ST 2024 | 3146022 | Mechanical Design IV Workshop | 1 SWS | / 🗣 | Düser, Burkardt |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105285 | Mechanical Design IV, tutorial | | | Albers, Matthiesen, Düser |

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

**Competence Certificate**
Concomitant to the lecture, a workshop with 3 workshop sessions takes place over the semester. During the workshop the students are divided into groups and their mechanical design knowledge will be tested during a colloquium at the beginning of every single workshop session. The attendance is mandatory and will be controlled. The pass of the colloquia and the process of the workshop task are required for the successful participation.

**Prerequisites**
None

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

## V Mechanical Design IV Workshop

3146022, SS 2024, 1 SWS, Language: English, Open in study portal **On-Site**

**Organizational issues**
Registration required, information on the IPEK website.

**Literature**
**Konstruktionselemente des Maschinenbaus -** 1 und 2
Grundlagen der Berechnung und Gestaltung von Maschinenelementen;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-22033-X

**Grundlagen von Maschinenelementen für Antriebsaufgaben**;
Steinhilper, Sauer, Springer Verlag, ISBN 3-540-29629-8

**CAD:**

3D-Konstruktion mit Pro/Engineer - Wildfire, Paul Wyndorps, Europa Lehrmittel, ISBN: 978-3-8085-8948-9

Pro/Engineer Tipps und Techniken, Wolfgang Berg, Hanser Verlag, ISBN: 3-446-22711-3 (für Fortgeschrittene)

# T 8.169 Course: Mechanics and Strength of Polymers [T-MACH-105333]

**Responsible:** Hon.-Prof. Dr. Bernd-Steffen von Bernstorff
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2173580 | Mechanics and Strengths of Polymers | 2 SWS | Lecture / 🗣 | von Bernstorff |

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

**Competence Certificate**
Oral exam, about 25 minutes

**Prerequisites**
none

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

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

## V Mechanics and Strengths of Polymers

2173580, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Molecular structure and morphology of polymers, temperature- and time dependency of mechanical behavior, viscoelasticity, time/temperature- superposition principle, yielding, crazing and fracture of polymers, failure criterions, impact and dynamic loading, corresponding principle, tough/brittle-transition, introduction to the principles of fiber reinforcement and multiple cracking in composites

**learning objectives:**

The students are prepared to

- repeat the calculus on strength and design of engineering parts exposed to complex loadings,
- estimate the influence of time and temperature on the strength of polymeric materials,
- relate the strength of materials to their molecular structure, morphology and processing parameters and
- derive failure mechanisms for homogenuous polymers and composite materials therefrom.

**requirements:**
basic knowledge in materials science (e.g. lecture materials science I and II)

**workload:**

The workload for the lecture Mechanics and Strengths of Polymers is 120 h per semester and consists of the presence during the lecture (28 h) as well as preparation and rework time at home (92 h).

**Organizational issues**
berndvonbernstorff@t-online.de

**Literature**
Literaturliste, spezielle Unterlagen und ein Teilmanuskript werden in der Vorlesung ausgegeben

# T 8.170 Course: Mechanics in Microtechnology [T-MACH-105334]

**Responsible:** Prof. Dr. Christian Greiner
Dr. Patric Gruber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2181710 | Mechanics in Microtechnology | 2 SWS | Lecture / 🗣 | Gruber, Greiner |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105334 | Mechanics in Microtechnology | | | Gruber, Greiner |
| WT 24/25 | 76-T-MACH-105334 | Mechanics in Microtechnology | | | Gruber, Greiner |

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

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

**Lecture (V)**
**On-Site**

**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,…

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

**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 8.171 Course: Metallographic Lab Class [T-MACH-105447]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier
Dr.-Ing. Alexander Kauffmann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2175590 | Metallographic Lab Class | 3 SWS | Practical course / 🗣 | Kauffmann |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-105447 | Metallographic Lab Class | | | Heilmaier, Kauffmann |

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

**Competence Certificate**
Colloquium for every experiment, about 60 minutes, protocol

**Prerequisites**
M-MACH-102562 - Materials Science must be passed.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The module M-MACH-102562 - Materials Science must have been passed.

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

## V Metallographic Lab Class

2175590, WS 24/25, 3 SWS, Language: German, Open in study portal

**Practical course (P)**
**On-Site**

**Content**
The lab course deals with the practical application of metallographic procedures, e.g. starting from sample extraction to light optical (LOM) and scanning electron microscopy (SEM). The preparation of metallographic samples takes up to two lab days. LOM and SEM analyses are performed on another two days. All results are carefully registered by the students and discussed in a spearate session. Finally, the students can independently apply their theoretical and practical knowledge by the preparation and analysis of industrial relevant metallic materials. The content of the lab course will be documented in the form of individual protocols by the students.

Before starting with the lab course, the students need to prepare the fundamentals that are tested in an online test. Lecture notes as starting point are provided.

**Learning objectives:**

The students can perform standard metallographic preparation routines as well as qualitative and quantitative microstructure analysis. The students are able to interpret microstructures and the correlations of microstructural constituent and processing and properties of metallic materials.

**Prerequisites:**

Materials Science and Engineering I and II or Materials Physics und Metals

**Arbeitsaufwand:**

on-site: 25 h
private studies: 95 h

**Literature**
Praktikumsskript

Weiterführende Informationen gibt es hier:

G. Gottstein: „Materialwissenschaft und Werkstofftechnik: Physikalische Grundlagen“, Springer (2014)
http://dx.doi.org/10.1007/978-3-642-36603-1 (frei über die KIT-Lizenz abrufbar)

J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
https://www.ifw-dresden.de/de/ifw-institutes/ikm/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften

P. Haasen: „Physikalische Metallkunde“, Cambridge University Press (2003)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC309606810

R.W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland (1996)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

D. A. Porter, K. Easterling: „Phase Transformation in Metals and Alloys“, Chapman & Hall (2009)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X

E. Hornbogen, H. Warlimont: „Metalle: Struktur und Eigenschaften von Metallen und Legierungen“, Springer (2016)
http://dx.doi.org/10.1007/978-3-662-47952-0 (frei über die KIT-Lizenz abrufbar)

E. Hornbogen, G. Eggeler, E. Werner: „Werkstoffe: Aufbau und Eigenschaften von Keramik-, Metall-, Polymer- und Verbundwerkstoffen“, Springer (2012)
http://dx.doi.org/10.1007/978-3-642-22561-1 (frei über die KIT-Lizenz abrufbar)

H.-J. Bargel, G. Schulze: „Werkstoffkunde“, Springer (2012)
http://dx.doi.org/10.1007/978-3-642-17717-0 (frei über die KIT-Lizenz abrufbar)

J. Rösler, H. Harders, M. Bäker: „Mechanisches Verhalten der Werkstoffe“, Springer Vieweg (2016)
http://dx.doi.org/10.1007/978-3-658-13795-3 (frei über die KIT-Lizenz abrufbar)

# T 8.172 Course: Microenergy Technologies [T-MACH-105557]

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

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2142897 | Microenergy Technologies | 2 SWS | Lecture / 🗣 | Kohl, Xu |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105557 | Microenergy Technologies | | | Kohl |
| WT 24/25 | 76-T-MACH-105557 | Microenergy Technologies | | | Kohl |

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

**Competence Certificate**
Oral examination (30 Min.)

**Prerequisites**
none

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

## V Microenergy Technologies

2142897, SS 2024, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**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 using different conversion principles (piezo, electrostatic, electromagnetic, etc.)
- Thermoelectric energy generation
- Novel thermal energy conversion principles (thermomagnetic, pyroelectric)
- Miniature scale solar devices
- RF energy harvesting
- Miniature scale heat pumping
- Solid-state cooling technologies (magneto-, electro-, mechanocalorics)
- Power management
- Energy storage technologies (microbatteries, supercapacito4rs, fuel cells)

**Literature**
- Folienskript "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 8.173 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-102746 - Compulsory Elective Module

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2183703 | Modelling and Simulation | | Lecture / Practice ( / 🗣 | Nestler, August, Prahs |
| WT 24/25 | 2183703 | Numerical methods and simulation techniques | 3 SWS | Lecture / Practice ( / 🗣 | Nestler, August, Prahs |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-100300 | Modelling and Simulation | | | Nestler |
| WT 24/25 | 76-T-MACH-100300 | Modelling and Simulation | | | Nestler, August, Prahs |

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

**Competence Certificate**
Successful participation in the computer internship (ungraded) and written exam, 90 min (graded)

**Prerequisites**
none

**Recommendation**
preliminary knowlegde in mathematics, physics and materials science

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

## V Modelling and Simulation

2183703, SS 2024, SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**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

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

**Organizational issues**
Die Termine für die Vorlesungen und für das Praktikum werden im ILIAS bekannt gegeben.

**Literature**

1. Scientific Computing, G. Golub and J.M. Ortega (B.G.Teubner Stuttgart 1996)

## V Numerical methods and simulation techniques

2183703, WS 24/25, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**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

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

**Organizational issues**
Termine für Rechnerübungen werden in der Vorlesung bekannt gegeben!

**Literature**

1. Scientific Computing, G. Golub and J.M. Ortega (B.G.Teubner Stuttgart 1996)

# T 8.174 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-102746 - Compulsory Elective Module
M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2183702 | Modelling of Microstructures | 3 SWS | Lecture / Practice ( / 🗣 | August, Prahs, Nestler |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105303 | Modelling of Microstructures | | | August, Nestler, Weygand |
| WT 24/25 | 76-T-MACH-105303 | Modelling of Microstructures | | | August, Weygand, Nestler |

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

**Competence Certificate**
oral exam 30 min

**Prerequisites**
none

**Recommendation**
materials science
fundamental mathematics

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

## V Modelling of Microstructures

2183702, WS 24/25, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**

- Brief Introduction in thermodynamics
- Gibbs free energy and phase diagrams
- Free energy functional
- Phasefield equation
- Driving forces
- Grand chemical potential functional and the evolution equations
- Numeric solution of the phasefield equation

The student can

- explain the thermodynamic and statistical foundations for liquid-solid and solid-solid phase transition processes and apply them to construct phase diagrams.
- explain the mechanisms of phase boundary motion induced under driving forces
- use the phase-field method for simulation of microstructure formation processes
- have experiences in computing and conduction simulations of microstructure formation from an integrated computer lab.

Knowledge in materials science and in fundamental mathematics recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

oral exam ca. 30 min

**Organizational issues**
Terminvereinbarung für die mündliche Prüfung: Sobald Sie wissen, wann Sie die Prüfung ablegen möchten, schreiben Sie bitte eine Mail an die Prüferin Anastasia August (anastasia.august2@kit.de) und schlagen Sie einen oder mehrere Termin/e vor. Die Prüfung dauert ca. 30 Minuten.

**Literature**

1. Gottstein, G. (2007) Physikalische Grundlagen der Materialkunde. Springer Verlag Berlin Heidelberg
2. Kurz, W. and Fischer, D. (1998) Fundamentals of Solidification. Trans Tech Publications ltd, Switzerland Germany UK USA
3. Porter, D.A. Eastering, K.E. and Sherif, M.Y. (2009) Phase transformation in metals and alloys (third edition). CRC Press, Taylor & Francis Group, Boca Raton, London, New York
4. Gaskell, D.R., Introduction to the thermodynamics of materials

# T 8.175 Course: Modern Control Concepts I [T-MACH-105539]

**Responsible:** apl. Prof. Dr. Lutz Groell
apl. Prof. Dr. Jörg Matthes

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2105024 | Modern Control Concepts I | 2 SWS | Lecture / | Matthes, Groell |
| ST 2024 | 2106020 | Tutorial on Modern Control Concepts I | 2 SWS | Practice / | Matthes |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105539 | Modern Control Concepts I | | | Matthes |

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

**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 2024, 2 SWS, Language: German, Open in study portal

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

**Literature**

- Aström, K.-J., Murray, R.M.: Feedback Systems, 2012
- Rugh, W.: Linear System Theory. Prentice Hall, 1996

## V Tutorial on Modern Control Concepts I

2106020, SS 2024, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**Online**

**Content**
**Learning Content:**

1. Introduction (system classes, nomenclature)
2. Equilibria
3. Linearization (software based, Hartman-Grobman-Theorem)
4. Parameter identification of linear dynamic models (SISO+MIMO)
5. PID-controller (realization, design-hints, Anti-Windup-mechanisms)
6. Conzept of 2DOF-Controllers (structure, reference signal design)
7. State space (geometric view)
8. Controller with state feedback and integrator expansion (LQ-design, Eigenvalue placement, decoupling design)
9. Observer (LQG-design, disturbance observer, reduced observer)

**Recommendations:**
Attendance of the following lectures is reccomendet:

- Grundlagen der Mess- und Regelungstechnik

Alternatively: Comparable courses of the faculty of electrical engineering

**Literature**


- Aström, K.-J., Murray, R.M.: Feedback Systems, 2012
- Rugh, W.: Linear System Theory. Prentice Hall, 1996

# T 8.176 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-102812 - Major Field: Powertrain Systems
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2141865 | Novel actuators and sensors | 2 SWS | Lecture / 🗣 | Kohl, Sommer |
| **Exams** | | | | | |
| ST 2024 | 7600010 | Novel Actuators and Sensors | | | Kohl |
| ST 2024 | 76-T-MACH-102152 | Novel Actuators and Sensors | | | Sommer, Kohl |
| WT 24/25 | 76-T-MACH-102152 | Novel Actuators and Sensors | | | Kohl, Sommer |

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

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

**Lecture (V)**
**On-Site**

**Literature**
- Vorlesungsskript "Neue Aktoren" und Folienskript "Sensoren"
- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007
- "Sensors Update", Edited by H.Baltes, W. Göpel, J. Hesse, VCH, 1996, ISBN: 3-527-29432-5
- "Multivariate Datenanalyse – Methodik und Anwendungen in der Chemie", R. Henrion, G. Henrion, Springer 1994, ISBN 3-540-58188-X

# T 8.177 Course: Numerical Fluid Mechanics [T-MACH-105338]

**Responsible:** Dr.-Ing. Davide Gatti
Dr.-Ing. Franco Magagnato

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2153441 | Numerical Fluid Mechanics | 4 SWS | Lecture / Practice ( / | Gatti |
| **Exams** | | | | | |
| ST 2024 | 76T-Mach-105338 | Numerical Fluid Mechanics | | | Gatti, Frohnapfel |
| WT 24/25 | 76T-Mach-105338 | Numerical Fluid Mechanics | | | Gatti, Frohnapfel |

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

**Competence Certificate**
oral exam - 30 minutes

**Prerequisites**
none

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

## V Numerical Fluid Mechanics

2153441, WS 24/25, 4 SWS, Language: German, Open in study portal

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

**Content**
The course covers the following topics:

1. basic equations of computational fluid dynamics
2. main discretization methods for fluid mechanics problems, with focus on finite differences and finite volumes
3. boundary and initial conditions
4. mesh generation and mesh treatment
6. solution algorithms for linear and nonlinear systems of equations
7. solution strategies for the incompressible Navier-Stokes equations
8. introduction to the solution of the compressible Navier-Stokes equations
9. examples of numerical simulation in practice

**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 8.178 Course: Participation in Empirical Research [T-MACH-112935]

**Responsible:** Prof. Dr.-Ing. Barbara Deml
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102576 - Key Competencies

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2111022 | Teilnahme an empirischer Forschung | | Others (sons | Deml |

**Competence Certificate**
The students participate as test subjects, spread over one or more semesters, in various empirical studies (e.g. laboratory experiments, questionnaire studies) of the KIT with a total of at least ten hours. Students are free to take studies from all faculties (e.g. mechanical engineering, sports science, industrial engineering, business informatics, see selected list on ifab-homepage). Participation and the scope (total of at least 10 hours) are confirmed on a form by the respective study leader and finally checked by the person responsible for the module and confirmed as academic achievement.

**Prerequisites**
none

# T 8.179 Course: Photovoltaics [T-ETIT-101939]

**Responsible:** Prof. Dr.-Ing. Michael Powalla
**Organisation:** KIT Department of Electrical Engineering and Information Technology
**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2313737 | Photovoltaics | 3 SWS | Lecture / | Powalla, Lemmer |
| ST 2024 | 2313738 | Tutorial 2313737 Photovoltaik | 1 SWS | Practice / | Powalla, Lemmer |
| **Exams** | | | | | |
| ST 2024 | 7313737 | Photovoltaics | | | Powalla, Lemmer |
| WT 24/25 | 7313737 | Photovoltaics | | | Powalla, Lemmer |

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

**Prerequisites**
"M-ETIT-100524 - Solar Energy" must not have started.

# T 8.180 Course: Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle [T-MACH-105537]

**Responsible:** apl. Prof. Dr. Ron Dagan
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2189906 | Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle | 2 SWS | Lecture / 🗣 | Dagan, Metz |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105537 | Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle | | | Dagan |
| WT 24/25 | 76-T-MACH-105537 | Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle | | | Dagan |

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

**Competence Certificate**
oral exam, approx. 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) On-Site**

2189906, WS 24/25, 2 SWS, Language: German, Open in study portal

**Content**

- Relevant physical terms of nuclear physics
- Decay heat removal- Borst-Wheeler equation
- The accidents in TMI- Three Mile Island, and Fukushima .
- Fission , chain reaction and reactor control systems
- Basics of nuclear cross sections
- Principles of reactor dynamics
- Reactor poisoning
- The Idaho and Chernobyl accidents
- Principles of the nuclear fuel cycle
- Reprocessing of irradiated fuel elements and vitrification of fission product solutions
- Interim storage of nuclear residues in surface facilities
- Multi barrier concepts for final disposal in deep geological formations
- The situation in the repositories Asse II, Konrad and Morsleben

The students

- understand the physical explanations of the known nuclear accidents
- can perform simplified calculations to demonstrate the accidents outcome.
- Define safety relevant properties of low/ intermediate / high level waste products
- Are able to evaluate principles and implications of reprocessing, storage and disposal options for nuclear waste.

Regular attendance: 14 h
self study 46 h
oral exam about 20 min.

**Literature**

AEA öffentliche Dokumentation zu den nukleare Ereignissen
K. Wirtz: Grundlagen der Reaktortechnik Teil I, II, Technische Hochschule Karlsruhe 1966
D. Emendorfer. K.H. Höcker: Theorie der Kernreaktoren, Teil I, II BI- Hochschultaschenbücher 1969
J. Duderstadt and L. Hamilton: Nuclear reactor Analysis, J. Wiley $ Sons , Inc. 1975 (in Englisch)
R.C. Ewing: The nuclear fuel cycle: a role for mineralogy and geochemistry. Elements vol. 2, p.331-339, 2006 (in Englisch)
J. Bruno, R.C. Ewing: Spent nuclear fuel. Elements vol. 2, p.343-349, 2006 (in Englisch)

# T 8.181 Course: Physical Basics of Laser Technology [T-MACH-102102]

**Responsible:** Dr.-Ing. Johannes Schneider
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102746 - Compulsory Elective Module

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 5 | Grade to a third | Each winter term | 4 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2181612 | Physical basics of laser technology | 3 SWS | Lecture / Practice ( / 🗣 | Schneider |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102102 | Physical Basics of Laser Technology | | | Schneider |
| WT 24/25 | 76-T-MACH-102102 | Physical Basics of Laser Technology | | | Schneider |

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

**Competence Certificate**
oral examination (30 min)

no tools or reference materials

**Prerequisites**
It is not possible, to combine this brick with brick Laser Material Processing [T-MACH-112763], 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-112763 - Laser Material Processing 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 24/25, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**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.

- 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.

**Organizational issues**
Termine für die Übung werden in der Vorlesung bekannt gegeben!

**Literature**
F. K. Kneubühl, M. W. Sigrist: Laser, 2008, Vieweg+Teubner

T. Graf: Laser - Grundlagen der Laserstrahlerzeugung 2015, Springer Vieweg

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

H. Hügel, T. Graf: Laser in der Fertigung, 2014, Springer Vieweg

J. Eichler, H.-J. Eichler: Laser - Bauformen, Strahlführung, Anwendungen, 2015, Springer

W. T. Silfvast: Laser Fundamentals, 2004, Cambridge University Press

W. M. Steen: Laser Material Processing, 2010, Springer

# T 8.182 Course: Physics for Engineers [T-MACH-100530]

**Responsible:** Prof. Dr. Martin Dienwiebel
Prof. Dr. Peter Gumbsch
apl. Prof. Dr. Alexander Nesterov-Müller
Dr. Daniel Weygand

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102746 - Compulsory Elective Module

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2142890 | Physics for Engineers | 4 SWS | Lecture / Practice ( / 🗣 | Weygand, Dienwiebel, Nesterov-Müller, Gumbsch |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-100530 | Physics for Engineers | | | Gumbsch, Weygand, Nesterov-Müller, Dienwiebel |

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

**Competence Certificate**
written exam 90 min

**Prerequisites**
none

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

V **Physics for Engineers** **Lecture / Practice (VÜ)**
2142890, SS 2024, 4 SWS, Language: German, Open in study portal **On-Site**

**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 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)
self-study: 105 hours

The assessment consists of a written exam (90 minutes) (following §4(2), 1 of the examination regulation).

**Organizational issues**
Kontakt: daniel.weygand@kit.edu

**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 8.183 Course: PLM-CAD Workshop [T-MACH-102153]

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

**Part of:** M-MACH-102583 - Major Field: Information Management

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Examination of another type | 4 | Grade to a third | Each term | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2121357 | PLM-CAD Workshop | 4 SWS | Project (P / 🗣 | Meyer, Mitarbeiter |
| WT 24/25 | 2121357 | PLM-CAD Workshop | 4 SWS | Project (P / 🗣 | Mitarbeiter, Rönnau |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102153 | PLM-CAD Workshop | | | Rönnau |

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

**Competence Certificate**
Alternative exam assessment (graded)

**Prerequisites**
None

**Annotation**
Number of participants is limited, compulsory attendance

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

## V PLM-CAD Workshop

2121357, SS 2024, 4 SWS, Language: German, Open in study portal

**Project (PRO)**
**On-Site**

**Content**
The aim of the workshop is to demonstrate the benefits of collaborative product development using PLM methods and to emphasize their added value compared to classical CAD development.

Students learn how to develop and produce a prototype with the help of modern PLM and CAx systems.

**Organizational issues**
Siehe Homepage zur Lehrveranstaltung

**Literature**
Workshop-Unterlagen / workshop materials

## V PLM-CAD Workshop

2121357, WS 24/25, 4 SWS, Language: German, Open in study portal

**Project (PRO)**
**On-Site**

**Content**
The aim of the workshop is to demonstrate the benefits of collaborative product development using PLM methods and to emphasize their added value compared to classical CAD development.

Students learn how to develop and produce a prototype with the help of modern PLM and CAx systems.

**Organizational issues**
Zeit und Ort siehe ILIAS

**Literature**
Workshop-Unterlagen / workshop materials

# T 8.184 Course: Polymer Engineering I [T-MACH-102137]

**Responsible:** Dr.-Ing. Wilfried Liebig
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2173590 | Polymer Engineering I | 2 SWS | Lecture / 🗣 | Liebig |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102137 | Polymer Engineering I | | | Liebig |
| WT 24/25 | 76-T-MACH-102137 | Polymer Engineering I | | | Liebig |

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

**Competence Certificate**
Oral exam, about 25 minutes

**Prerequisites**
none

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

## V Polymer Engineering I

2173590, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
1. Economical aspects of polymers
2. Introductiom of mechanical,
chemical end electrical properties
3. Processing of polymers
(introduction)
4. Material science of polymers
5. Synthesis

**learning objectives:**

The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, to equip the students with knowledge and technical skills, and to use the material "polymer" meeting its requirements in an economical and ecological way.

The students

- are able to describe and classify polymers
based on the fundamental synthesis processing techniques
- can find practical applications for state-of-the-art polymers and manufacturing technologies
- are able to apply the processing techniques, the application of polymers and polymer composites regarding to the basic principles of material science
- can describe the special mechanical, chemical and elctrical prooperties of polymers and correlate these properties to the chemical bindings.
- can define application areas and the limitation in the use of polymers

**requirements:**
none

**workload:**

regular attendance: 21 hours
self-study: 99 hours

**Literature**
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.

# T 8.185 Course: Powertrain Systems Technology B: Stationary Machinery [T-MACH-105216]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2145150 | Powertrain Systems Technology B: Stationary Machinery | 2 SWS | Lecture / 🗣 | Düser, Ott |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105216 | Powertrain Systems Technology B: Stationary Machinery | | | Albers, Ott |
| WT 24/25 | 76-T-MACH-105216 | Powertrain Systems Technology B: Stationary Machinery | | | Albers, Ott |

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

**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

2145150, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Students acquire the basic skills needed to develop future energy-efficient and safe drive system solutions for use in industrial environments. The course considers holistic development methods and evaluations of drive systems. The focal points can be divided into the following chapters:

- Powertrain System
- Operator System
- Environment System
- System Components
- Development Process

**Recommendations:**

- Powertrain Systems Technology A: Automotive Systems

**Literature**
VDI-2241: "Schaltbare fremdbetätigte Reibkupplungen und -bremsen", VDI Verlag GmbH, Düsseldorf

Geilker, U.: "Industriekupplungen - Funktion, Auslegung, Anwendung", Die Bibliothek der Technik, Band 178, verlag moderne industrie, 1999

# T 8.186 Course: Practical course in robot programming with Python [T-MACH-113670]

**Responsible:** Prof. Dr.-Ing. Arne Rönnau
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-102583 - Major Field: Information Management

| Type | Credits | Grading scale | Expansion | Version |
|---|---|---|---|---|
| Completed coursework | 4 | pass/fail | 1 terms | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2121340 | Practical course in robot programming with Python | 3 SWS | Practical course / 🗣 | Rönnau |

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

**Competence Certificate**
The academic achievement is carried out using walking robots. The overall impression made during the internship is assessed:

- Participation and engagement in workshops on robot programming basics
- Group work in teams of 4 people
- Demonstration of the results in the final robot competition between the teams

**Prerequisites**
none

**Annotation**
Limited number of participants.

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

## V Practical course in robot programming with Python

2121340, WS 24/25, 3 SWS, Language: English, Open in study portal

**Practical course (P)**
**On-Site**

**Content**
The practical course teaches the basics of programming mobile robots. The most important syntax elements of Python are first repeated and the framework requirements and the relevant development tools are introduced. The modern four-legged walking robot Go2 from the company Unitree is used in the practical course. This robot has numerous sensors and motors that need to be read out and controlled in order to solve complex tasks. The open source framework ROS2, which is used intensively in robotics research, serves as the basis for the practical course. However, the focus of the course is on programming basic, key robotic functions using Python and not on the complex ROS2 framework.

Qualification goals

Students will be able to programme new software components and functions for mobile robots using Python. Therefore, students know the basic elements of a mobile robot and its programming and development environment. They will be able to add their own software elements in the right sections of an existing development project or adapt existing ones and execute their code on the robot. The different requirements and framework conditions for programming software for perception, task and motion planning and control or interaction are known and can be taken into account when developing Python software.

**Organizational issues**
Kick-off (Auftakt) Tue 22 Oct 15:45 Bldg. 20.20 MaiRo-Lab ground floor

# T 8.187 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-102820 - Major Field: Mechatronics
M-MACH-104442 - Major Field: Vibration Theory

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 4 | pass/fail | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162208 | Schwingungstechnisches Praktikum | | Practical course / ✕ | Genda, Fidlin |

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

**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 8.188 Course: Presentation [T-MACH-109189]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-104494 - Bachelor's Thesis

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 3 | pass/fail | Each term | 1 |

**Competence Certificate**
The colloquium presentation must be held within 6 weeks after the submission of the bachelor thesis. The presentation should last around 20 minutes followed by a scientific discussion with the present expert audience. The students should show that they are able to independently present and discuss the content of their bachelor thesis according to scientific criteria.

**Prerequisites**
Bachelor Thesis has been started

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-109188 - Bachelor's Thesis must have been started.

**Annotation**
The workload for the presentation of the bachelor thesis is about 90 hours.

# T 8.189 Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

**Responsible:** apl. Prof. Dr. Günter Schell
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2193010 | Basic principles of powder metallurgical and ceramic processing | 2 SWS | Lecture / | Schell |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102111 | Principles of Ceramic and Powder Metallurgy Processing | | | Schell |
| WT 24/25 | 76-T-MACH-102111 | Principles of Ceramic and Powder Metallurgy Processing | | | Schell, Wagner |

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

**Competence Certificate**
The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

**Prerequisites**
none

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

## V Basic principles of powder metallurgical and ceramic processing

2193010, WS 24/25, 2 SWS, Language: German, Open in study portal

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

**Literature**


- R.J. Brook: Processing of Ceramics I+II, VCH Weinheim, 1996
- M.N. Rahaman: Cermamic Processing and Sintering, 2nd Ed., Marcel Dekker, 2003
- W. Schatt ; K.-P. Wieters ; B. Kieback. ".Pulvermetallurgie: Technologien und Werkstoffe", Springer, 2007
- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
- F. Thümmler, R. Oberacker. "Introduction to Powder Metallurgy", Institute of Materials, 1993

# T 8.190 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-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2149670 | Product- and Production-Concepts for modern Automobiles | 2 SWS | Lecture / | Steegmüller, Kienzle |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-110318 | Product- and Production-Concepts for modern Automobiles | | | Steegmüller, Kienzle |

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

**Competence Certificate**
Oral Exam (20 min)

**Prerequisites**
T-MACH-105166 - Materials and Processes for Body Leightweight Construction in the Automotive Industry must not have been started.

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

## V Product- and Production-Concepts for modern Automobiles

2149670, WS 24/25, 2 SWS, Language: German, Open in study portal

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

**Content**
The lecture illuminates the practical challenges of modern automotive engineering. As former leaders of the automotive industry, the lecturers refer to current aspects of automotive product development and production.

The aim is to provide students with an overview of technological trends in the automotive industry. In this context, the course also focuses on changes in requirements due to new vehicle concepts, which may be caused by increased demands for individualisation, digitisation and sustainability. The challenges that arise in this context will be examined from both a production technology and product development perspective and will be illustrated with practical examples thanks to the many years of industrial experience of both lecturers.

The topics covered are:

- General conditions for vehicle and body development
- Integration of new drive technologies
- Functional requirements (crash safety etc.), also for electric vehicles
- Development Process at the Interface Product & Production, CAE/Simulation
- Energy storage and supply infrastructure
- Aluminium and lightweight steel construction
- FRP and hybrid parts
- Battery, fuel cell and electric motor production
- Joining technology in modern car bodies
- Modern factories and production processes, Industry 4.0.

**Learning Outcomes:**

The students …

- are able to name the presented general conditions of vehicle development and are able to discuss their influences on the final product using practical examples.
- are able to name the various lightweight approaches and identify possible areas of application.
- are able to identify the different production processes for manufacturing lightweight structures and explain their functions.
- are able to perform a process selection based on the methods and their characteristics.

**Workload:**

regular attendance: 25 hours
self-study: 95 hours

**Organizational issues**
Termine werden über Ilias bekannt gegeben.

Bei der Vorlesung handelt es sich um eine Blockveranstaltung. Eine Anmeldung über Ilias ist erforderlich.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The lecture is a block course. An application in Ilias is mandatory.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

**Literature**
**Medien**:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.191 Course: Product Lifecycle Management [T-MACH-105147]

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

**Part of:** M-MACH-102583 - Major Field: Information Management
M-MACH-102589 - Major Field: Production Systems
M-MACH-102746 - Compulsory Elective Module

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2121350 | Product Lifecycle Management | 2 SWS | Lecture / 🗣 | Ovtcharova, Elstermann |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105147 | Product Lifecycle Management | | | Ovtcharova, Elstermann |
| WT 24/25 | 76-T-MACH-105147 | Product Lifecycle Management | | | Ovtcharova, Elstermann |

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

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

**Lecture (V)**
**On-Site**

**Content**
The course includes:

- Basics for product data management and data exchange
- IT system solutions for Product Lifecycle Management (PLM)
- Economic viability analysis and implementation problems
- Illustrative scenario for PLM using the example of the institute's own I4.0Lab

After successful attendance of the course, students can:

- identify the challenges of data management and exchange and describe solution concepts for these challenges.
- clarify the management concept PLM and its goals and highlight the economic benefits.
- explain the processes required to support the product life cycle and describe the most important business software systems (PDM, ERP, ...) and their functions.

**Literature**
Vorlesungsfolien.

V. Arnold et al: Product Lifecycle Management beherrschen, Springer-Verlag, Heidelberg, 2005.

J. Stark: Product Lifecycle Management, 21st Century Paradigm for Product Realisation, Springer-Verlag, London, 2006.

A. W. Scheer et al: Prozessorientiertes Product Lifecycle Management, Springer-Verlag, Berlin, 2006.

J. Schöttner: Produktdatenmanagement in der Fertigungsindustrie, Hanser-Verlag, München, 1999.

M.Eigner, R. Stelzer: Produktdaten Management-Systeme, Springer-Verlag, Berlin, 2001.

G. Hartmann: Product Lifecycle Management with SAP, Galileo press, 2007.

K. Obermann: CAD/CAM/PLM-Handbuch, 2004.

# T 8.192 Course: Product, Process and Resource Integration in the Automotive Industry [T-MACH-102155]

**Responsible:** Prof. Dr.-Ing. Sama Mbang
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102583 - Major Field: Information Management
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2123364 | Product, Process and Resource Integration in the Automotive Industry | 2 SWS | Lecture / Practice ( / | Mbang |

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

**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 / Practice (VÜ) On-Site**

2123364, SS 2024, 2 SWS, Language: German, Open in study portal

**Content**

- 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)

**Organizational issues**
Blockveranstaltung

**Literature**
Vorlesungsfolien

# T 8.193 Course: Production Technology for E-Mobility [T-MACH-110984]

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

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2150605 | Production Technology for E-Mobility | 2 SWS | Lecture / 🗣 | Fleischer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-110984 | Production Technology for E-Mobility | | | Fleischer |
| WT 24/25 | 76-T-MACH-110984 | Production Technology for E-Mobility | | | Fleischer |

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

**Competence Certificate**
Written Exam (60 min)

**Prerequisites**
none

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

## V Production Technology for E-Mobility

2150605, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
In the lecture Production Engineering for Electromobility the students should be enabled to design, select and develop production processes for the production of the components of an electric drive train (electric motor, battery cells, fuel cells) by using research-oriented teaching.

**Learning Outcomes:**

The students are able to:

- describe the structure and function of a fuel cell, an electric traction drive and a batterysystem.
- reproduce the process chains for the production of the components fuel cell, battery and electric traction drive.
- apply methodical tools to solve problems along the process chain.
- derive the challenges in the production of electric drives for electric mobility.
- describe the factors influencing the individual process steps on each other using the process chain of Li-ion battery cells.
- enumerate or describe the necessary process parameters to counteract the influencing factors of the process steps in Li-ion battery cell production.
- apply methodical tools to solve problems along the process chain for the production of Li-ion battery cells.
- derive the challenge of mounting and dismounting battery modules.
- derive the challenges in the production of fuel cells for use in mobility.

**Workload:**

regular attendance: 42 hours
self-study: 78 hours

**Organizational issues**
Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

**Literature**
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.194 Course: Programming in CAE-Applications [T-MACH-111431]

**Responsible:** Prof. Dr.-Ing. Luise Kärger
**Organisation:** KIT Department of Mechanical Engineering
Lightweight Design
**Part of:** M-MACH-102815 - Major Field: Engineering Design

| Type | Credits | Grading scale | Recurrence | Expansion | Version |
|---|---|---|---|---|---|
| Completed coursework | 4 | pass/fail | Each winter term | 1 terms | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113109 | Programming in CAE-Applications | 2 SWS | Practical course / | Kärger |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-111431 | Programming in CAE-Applications | | | Kärger |

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

**Competence Certificate**
Colloquia on exercises during the semester and presentation of a group task at the end of the semester (ungraded)

**Prerequisites**
The number of participating students is limited. Details for the admission process can be found in the category "Organizational issues" of the associated event.

**Recommendation**

- Basics of the finite element method (ideally with Abaqus)
- Basic knowledge of continuum mechanics
- Basics of programming
- Basic knowledge of fibre-reinforced polymers

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

**V Programming in CAE-Applications** — **Practical course (P)** **Blended (On-Site/Online)**
2113109, WS 24/25, 2 SWS, Language: German, Open in study portal

**Content**
The development of components supported by numerical simulations, for example through the finite element method (FEM), has become an indispensable part of modern engineering work. They allow a virtual evaluation of different component variants and thus contribute to an efficient product development process. For the correct use of CAE methods and the generation of reliable simulation results, knowledge of the methodological background and a goal-oriented approach for the model setup and simulation evaluation is essential. Thereby, recurring problems can be solved efficiently and automatically by programming sequence and evaluation scripts. The investigation of modern material systems such as continuous fiber-reinforced plastics represents an additional challenge. For these complex materials, there is often a lack of commercially available methods, which is why the implementation of user-defined material models through suitable subroutines is increasingly necessary.

In this workshop, students learn about the everyday work of computational engineers. Step by step, the basics of the finite element method are worked out using practical examples in Abaqus, as well as typical procedures for model setup and evaluation. Building on this, basic knowledge of script programming in Python and the implementation of material models in Fortran subroutines is taught. The aim of the course is to illustrate the contents in an application-oriented manner through a combination of lectures, supervised classroom exercises and solving project tasks in small groups during the semester.

**Main topics:**

- Fundamentals of FE structural simulations with anisotropic materials using continuous fiber-reinforced plastics as an example (Abaqus)
- Automated model setup and evaluation with Python scripts
- Efficient evaluation of the result quality of FE-simulations
- Derivation of measures to improve structural load-bearing capacity
- User-defined material modelling (Fortran subroutines)

**Learning Objectives:**

Students will be able to

- understand the basics of the finite element method and use the FE software Abaqus to solve practical calculation tasks,
- automate the FE model generation as well as the result evaluation,
- evaluate the simulation results, identify errors and derive conclusions for improving the load-bearing capacity,
- understand the basics for developing material subroutines and implement them for simple examples.

**Organizational issues**
Die Veranstaltung findet immer dienstags um 15:45 Uhr am Campus Ost in Geb. 70.04, Raum 219 statt.

Aufgrund des gewünschten Betreuungsverhältnisses und der Institutsausstattung ist die maximale Anzahl der teilnehmenden Studierenden begrenzt. Die vorläufige Anmeldung erfolgt über das zugehören Formular auf der Instituts-Homepage (https://www.fast.kit.edu/lbt/1205.php), welches Mitte September dort zusammen mit weiteren Details veröffentlicht wird. Bei zu vielen Interessenten findet eine Auswahl unter allen Interessenten statt.

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The event takes place every Tuesday at 3:45 p.m. on Campus East in building 70.04, room 219.

Due to the desired supervision ratio and the institute's equipment, the maximum number of participating students is limited. Preliminary registration takes place via the associated form on the Institute's homepage (https://www.fast.kit.edu/lbt/1205.php), which will be published there together with further details in the mid of September. If there are too many interested students, a selection will take place among all interested students.

# T 8.195 Course: Project Internship Additive Manufacturing: Development and Production of an Additive Component [T-MACH-110960]

**Responsible:** Prof. Dr.-Ing. Frederik Zanger
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102589 - Major Field: Production Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2149700 | Project Internship Aditive Manufacturing: Development and Production of an Additive Component | 2 SWS | Practical course / 🗣 | Zanger, Frey |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-110960 | Project Internship Aditive Manufacturing: Development and Production of an Additive Component | | | Zanger |

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

**Competence Certificate**
Alternative test achievement (graded)

The competence certificate is a project work; alternative test achievement according to § 4 Abs. 2 No. 3 of the SPO. Here, the project work, the milestone-based presentation of the results in presentation form (10 min each) and a final oral examination (15 min) are included in the assessment.

**Prerequisites**
none

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

## V Project Internship Aditive Manufacturing: Development and Production of an Additive Component

**Practical course (P)**
**On-Site**

2149700, WS 24/25, 2 SWS, Language: German, Open in study portal

**Content**
The lecture "Project Internship Additive Manufacturing: Development and Production of an Additive Component" combines the basics of metallic laser powder bed fusion (LPBF) with a development project in cooperation with an industrial company.
The students learn the basics of the following topics in the project-related lecture:

- Influence of different process variables on the component quality of parts produced in the LPBF process
- Preparation and simulation of the LPBF process
- Production of additive metallic components
- Process monitoring and quality assurance in additive manufacturing
- Topology optimization
- CAM for subtractive rewor

The topics addressed in the course will be applied practically in various workshops on the individual topics and transferred to the developmental task in self-study.
Finally, the results of the elaborations are produced additively and post-processed subtractively.

**Learning Outcomes:**

The students …

- are able to describe the properties and applications of the additive manufacturing processes laser powder bed fusion (LPBF).
- are able to select the appropriate manufacturing process for a technical application.
- are able to describe and implement the creation of a product along the entire additive process chain (CAD, simulation, work preparation, CAM) from the idea to the production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization.
- are able to simulate the additive process, compensate for process-related distortions and determine the ideal alignment on the building platform.
- are able to create necessary support structures for the additive process and to derive a building order file.
- are able to create a CAM model for the subtractive rework process of additive parts.

**Workload:**

regular attendance: 12 hours
self-study: 108 hours

**Organizational issues**
Die Veranstaltung beginnt mit einer Blockveranstaltung vor Semesterbeginn. Während des Semesters finden nur einzelne Pflichtveranstaltungen statt. Die genauen Termine werden über die Vorlesungsankündigung des wbk mitgeteilt: http://www.wbk.kit.edu/studium-und-lehre.php

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Der Link zur Bewerbung wird in der Vorlesungsankündigung über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php) zur Verfügung gestellt.

**Literature**
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

# T 8.196 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-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2115817 | Project Workshop: Automotive Engineering | 3 SWS | Lecture / 🗣 | Gauterin, Gießler, Frey |
| WT 24/25 | 2115817 | Project Workshop: Automotive Engineering | 3 SWS | Lecture / 🗣 | Gießler, Frey |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102156 | Project Workshop: Automotive Engineering | | | Gauterin |

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

**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 2024, 3 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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.

Learning Objectives:

The students are familiar with typical industrial development processes and working style. They are able to apply knowledge gained at the university to a practical task. They are able to analyze and to judge complex relations. They are ready to work self-dependently, to apply different development methods and to work on approaches to solve a problem, to develop practice-oriented products or processes.

**Organizational issues**
Begrenzte Teilnehmerzahl mit Auswahlverfahren, die Bewerbungen sind am Ende des vorhergehenden Semesters einzureichen.

Raum und Termine: s. Aushang bzw. Homepage

**Literature**
Steinle, Claus; Bruch, Heike; Lawa, Dieter (Hrsg.), Projektmanagement, Instrument moderner Innovation, FAZ Verlag, Frankfurt a. M., 2001, ISBN 978-3929368277

Skripte werden beim Start-up Meeting ausgegeben.

## V Project Workshop: Automotive Engineering

**Lecture (V)**
**On-Site**

2115817, WS 24/25, 3 SWS, Language: German, Open in study portal

**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.

Learning Objectives:

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.

**Organizational issues**
Begrenzte Teilnehmerzahl mit Auswahlverfahren, in deutscher Sprache. Bewerbungen sind am Ende des vorhergehenden Semesters einzureichen.
Termin und Raum: siehe Institutshomepage.

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.

**Literature**
Steinle, Claus; Bruch, Heike; Lawa, Dieter (Hrsg.), Projektmanagement, Instrument moderner Innovation, FAZ Verlag, Frankfurt a. M., 2001, ISBN 978-3929368277

Skripte werden beim Start-up Meeting ausgegeben.

The scripts will be supplied in the start-up meeting.

# T 8.197 Course: Python Algorithm for Vehicle Technology [T-MACH-110796]

**Responsible:** Stephan Rhode
**Organisation:**
**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114862 | Python Algorithms for Automotive Engineering | 2 SWS | Lecture / ✕ | Rhode |

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

**Competence Certificate**
Written Examination

Duration: 90 minutes

**Prerequisites**
none

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

## V Python Algorithms for Automotive Engineering

2114862, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V) Cancelled**

**Content**
Teaching content:

- Introduction to Python and useful tools and libraries for creating algorithms, graphical representation, optimization, symbolic arithmetic and machine learning
  - Anaconda, Pycharm, Jupyter
  - NumPy, Matplotlib, SymPy, Scikit-Learn
- Methods and tools for creating software
  - Version management GitHub, git
  - Testing software pytest, Pylint
  - Documentation Sphinx
  - Continuous Integration (CI) Travis CI
  - Workflows in Open Source and Inner Source, Kanban, Scrum
- Practical programming projects to:
  - Road sign recognition
  - Vehicle state estimation
  - Calibration of vehicle models by mathematical optimization
  - Data-based modelling of the powertrain of an electric vehicle

Objectives:

The students have an overview of the programming language Python and important Python libraries to solve automotive engineering problems with computer programs. The students know current tools around Python to create algorithms, to apply them and to interpret and visualize their results. Furthermore, the students know
basics in the creation of software to be used in later programming projects in order to develop high-quality software solutions in teamwork. Through practical programming projects (road sign recognition, vehicle state estimation, calibration, data-based modelling), the students can perform future complex tasks from the area of driver assistance systems.

**Organizational issues**
Die Vorlesung wird im erst wieder im Sommersemester 2025 stattfinden.

**Literature**


- A Whirlwind Tour of Python, Jake VanderPlas, Publisher: O'Reilly Media, Inc. Release Date: August 2016, ISBN: 9781492037859 link
- Scientific Computing with Python 3, Olivier Verdier, Jan Erik Solem, Claus Führer, Publisher: Packt Publishing, Release Date: December 2016, ISBN: 9781786463517 link
- Introduction to Machine Learning with Python, Sarah Guido, Andreas C. Müller, Publisher: O'Reilly Media, Inc., Release Date: October 2016, ISBN: 9781449369880, link
- Clean Code, Robert C. Martin, Publisher: Prentice Hall, Release Date: August 2008, ISBN: 9780136083238, link

# T 8.198 Course: Quality Management [T-MACH-102107]

**Responsible:** Prof. Dr.-Ing. Gisela Lanza
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102589 - Major Field: Production Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102821 - Major Field: Technical Logistics

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

| **Events** | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2149667 | Quality Management | 2 SWS | Lecture / | Lanza, Stamer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102107 | Quality Management | | | Lanza |
| WT 24/25 | 76-T-MACH-102107 | Quality Management | | | Lanza |

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

**Competence Certificate**
Written Exam (60 min)

**Prerequisites**
It is not possible to combine this brick with brick Quality Management [T-MACH-112586].

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

## V Quality Management

2149667, WS 24/25, 2 SWS, Language: German, Open in study portal

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

**Content**
Based on the quality philosophies Total Quality Management (TQM) and Six Sigma, the lecture deals with the requirements of modern quality management. Within this context, the process concept of a modern enterprise and the process-specific fields of application of quality assurance methods are presented. The lecture covers the current state of the art in preventive and non-preventive quality management methods in addition to manufacturing metrology, statistical methods and service related quality management. The content is completed with the presentation of certification possibilities and legal quality aspects.

Main topics of the lecture:

- The term "Quality"
- Total Quality Management (TQM) and Six Sigma
- Universal methods and tools
- QM during early product stages – product denition
- QM during product development and in procurement
- QM in production – manufacturing metrology
- QM in production – statistical methods
- QM in service
- Quality management systems
- Legal aspects of QM

**Learning Outcomes:**

The students …

- are capable to comment on the content covered by the lecture.
- are capable of substantially quality philosophies.
- are able to apply the QM tools and methods they have learned about in the lecture to new problems from the context of the lecture.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about in the lecture for a specific problem.

**Workload:**

regular attendance: 21 hours
self-study: 99 hours

**Organizational issues**
Vorlesungstermine montags 09:45 Uhr
Übung erfolgt während der Vorlesung

**Literature**
**Medien**:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt:

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

# T 8.199 Course: Rail System Technology [T-MACH-106424]

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

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2115919 | Rail System Technology | 2 SWS | Lecture / 🗣 | Cichon |
| WT 24/25 | 2115919 | Rail System Technology | 2 SWS | Lecture / 🗣 | Cichon |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-106424 | Rail System Technology | | | Cichon, Ziesel, Berthold |
| WT 24/25 | 76-T-MACH-106424 | Rail System Technology | | | Cichon |

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

**Competence Certificate**
oral examination in German language
Duration: approx. 30 minutes
No tools or reference materials may be used during the exam except calculator and dictionary

**Prerequisites**
none

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

## V Rail System Technology

2115919, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

**Organizational issues**
ab SS 2024 schriftliche Prüfung

**Literature**
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

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

## V Rail System Technology

2115919, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

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

# T 8.200 Course: Rail Vehicle Technology [T-MACH-105353]

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

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2115996 | Rail Vehicle Technology | 2 SWS | Lecture / 🗣 | Cichon |
| WT 24/25 | 2115996 | Rail Vehicle Technology | 2 SWS | Lecture / 🗣 | Cichon |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105353 | Rail Vehicle Technology | | | Cichon, Ziesel, Berthold |
| WT 24/25 | 76-T-MACH-105353 | Rail Vehicle Technology | | | Cichon |

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

**Competence Certificate**
oral examination in German language
Duration: approx 30 minutes
No tools or reference materials may be used during the exam except calculator and dictionary

**Prerequisites**
none

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

## V Rail Vehicle Technology

2115996, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
3. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
4. Drives: priciples, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisystem vehicles, dual mode vehicles, hybrid vehicles), non-electric drives
5. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck vehicles, locomotives, freight wagons

**Organizational issues**
ab SS 2024 schriftliche Prüfung

**Literature**
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

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

## V Rail Vehicle Technology

2115996, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
3. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
4. Drives: priciples, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisystem vehicles, dual mode vehicles, hybrid vehicles), non-electric drives
5. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck vehicles, locomotives, freight wagons

**Literature**
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

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

# T 8.201 Course: Railways in the Transportation Market [T-MACH-105540]

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

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114914 | Railways in the Transportation Market | 2 SWS | Block / 🗣 | Cichon |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105540 | Railways in the Transportation Market | | | Cichon |

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

**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 2024, 2 SWS, Language: German, Open in study portal

**Block (B)**
**On-Site**

**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 in Germany
- Overview of Deutsche Bahn
- Regulation of railways
- Financing and development of rail infrastructure
- Group strategy “Strong Rail” and their building blocks:
  (climate, environment, digitalization, “Strong Rail” in Baden-Württemberg)
- Trends in the transportation market
- Field of actions in transport policy
- Intra- and intermodal competition
- Summary

**Learning Objectives:**

- To capture the entrepreneurial perspective on transport companies
- To appraise the intra- and intermodal competition
- To understand the regulative determinant
- To reflect trends in transportation market
- To comprehend strategic challenges, chances and fields of actions of transport companies
- To apply intermodal perspective
- To take important key figures of railways and transportation market
- To realize the relevance of sustainability and digitalization

**Organizational issues**
Die Blockvorlesung „Die Eisenbahn im Verkehrsmarkt" findet am **20.06./21.06./22.06.2024 von 9.00 bis 16.00 Uhr** am Campus Ost. Geb. 70.04, R 220 in Präsenz statt. Die Prüfung findet am 11.07.2024 in Präsenz statt.
Näheres siehe Homepage http://www.fast.kit.edu/bst/929.php

**Literature**
keine

# T 8.202 Course: Re:Invent - Revolutionary Business Models as the Basis for Product Innovations [T-MACH-111888]

**Responsible:** Dr.-Ing. Thomas Schneider
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-102815 - Major Field: Engineering Design

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2147177 | Re:Invent - Revolutionary Business Models as the Basis for Product Innovations (Lecture) | 2 SWS | Lecture / 🗣 | Schneider |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-111888 | Re:Invent - Revolutionary business models as the basis for product innovations | | | Schneider, Matthiesen |

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

**Competence Certificate**
Oral exam, duration: approx. 20 minutes

**Prerequisites**
None

# T 8.203 Course: Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society [T-FORUM-113587]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**

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

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 0 | pass/fail | Each term | 1 |

**Prerequisites**
In order to register, it is mandatory that the basic module and the advanced module have been completed and that the grades for the partial performances in the advanced module are available.

# T 8.204 Course: Robotics I - Introduction to Robotics [T-INFO-108014]

**Responsible:** Prof. Dr.-Ing. Tamim Asfour
**Organisation:** KIT Department of Informatics
**Part of:** M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2424152 | Robotics I - Introduction to Robotics | | Lecture / 🗣 | Asfour |
| **Exams** | | | | | |
| ST 2024 | 7500218 | Robotik I - Einführung in die Robotik | | | Asfour |
| WT 24/25 | 7500106 | Robotics I - Introduction to Robotics | | | Asfour |

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

**Competence Certificate**
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 120 minutes.

**Prerequisites**
none.

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

## V Robotics I - Introduction to Robotics

2424152, WS 24/25, SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
The lecture provides an overview of the fundamentals of robotics using the examples of industrial robots, service robots and autonomous humanoid robots. An insight into all relevant topics is given. This includes methods and algorithms for robot modeling, control and motion planning, image processing and robot programming. First, mathematical basics and methods for kinematic and dynamic robot modeling, trajectory planning and control as well as algorithms for collision-free motion planning and grasp planning are covered. Subsequently, basics of image processing, intuitive robot programming especially by human demonstration and symbolic planning are presented.

In the exercise, the theoretical contents of the lecture are further illustrated with examples. Students deepen their knowledge of the methods and algorithms by independently working on problems and discussing them in the exercise. In particular, students can gain practical programming experience with tools and software libraries commonly used in robotics.

### Workload:

Lecture with 3 SWS + 1 SWS Tutorial, 6 LP

6 LP corresponds to 180 hours, including

15 * 3= 45 hours attendance time (lecture)

15 * 1= 15 hours attendance time (tutorial)

15 * 6= 90 hours self-study and exercise sheets

30 hours preparation for the exam

### Competency Goals:

The students are able to apply the presented concepts to simple and realistic tasks from robotics. This includes mastering and deriving the mathematical concepts relevant for robot modeling. Furthermore, the students master the kinematic and dynamic modeling of robot systems, as well as the modeling and design of simple controllers. The students know the algorithmic basics of motion and grasp planning and can apply these algorithms to problems in robotics. They know algorithms from the field of image processing and are able to apply them to problems in robotics. They are able to model and solve tasks as a symbolic planning problem. The students have knowledge about intuitive programming procedures for robots and know procedures for programming and learning by demonstration.

**Organizational issues**
Die Erfolgskontrolle erfolgt in Form einer schriftlichen Prüfung im Umfang von i.d.R. 120 Minuten nach § 4 Abs. 2 Nr. 1 SPO.

**Modul für Bachelor/Master Informatik, Maschinenbau, Mechatronik und Informationstechnik, Elektrotechnik und Informationstechnik**

**Literature**
**Weiterführende Literatur**

Fu, Gonzalez, Lee: Robotics - Control, Sensing, Vision, and Intelligence

Russel, Norvig: Artificial Intelligence - A Modern Approach, 2nd. Ed.

# T 8.205 Course: Safety Engineering [T-MACH-105171]

**Responsible:** Hans-Peter Kany
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102821 - Major Field: Technical Logistics

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2117061 | Safety Engineering | 2 SWS | Lecture / 🗣 | Kany |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105171 | Safety Engineering | | | Furmans |

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

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

**Lecture (V)**
**On-Site**

**Content**
**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

**Organizational issues**
Termine: siehe ILIAS.

**Literature**
Defren/Wickert: Sicherheit für den Maschinen- und Anlagenbau, Druckerei und
Verlag: H. von Ameln, Ratingen

# T 8.206 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-102746 - Compulsory Elective Module

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2181738 | Scientific computing for Engineers | 2 SWS | Lecture / 🗣 | Weygand, Gumbsch |
| WT 24/25 | 2181739 | Exercises for Scientific Computing for Engineers | 2 SWS | Practice / 🗣 | Weygand |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-100532 | Scientific Computing for Engineers | | | Weygand, Gumbsch |
| WT 24/25 | 76-T-MACH-100532 | Scientific Computing for Engineers | | | Weygand, Gumbsch |

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

**Competence Certificate**
Written exam (90 minutes)

**Prerequisites**
The brick can not be combined with the brick "Application of advanced programming languages in mechanical engineering" (T-MACH-105390).

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

## V Scientific computing for Engineers

2181738, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
1. Introduction: why scientific computing
2. computer architectures
3. Introduction to Unix/Linux
4. Foundations of C++
* progamm organization
* data types, operator, control structures
* dynamic memory allocation
* functions
* class
* OpenMP parallelization
5. numeric /algorithms
* finite differences
* MD simulations: 2nd order differential equations
* algorithms for particle simulations
* solver for linear systems of eqns.

The student can

- apply the programming language C++ for scientific computing in the field of materials science
- adapt programs for use on parallel platforms
- choose suitable numerical methods for the solution of differential equations.

The lecture can not be combined with the lecture "Application of advanced programming languages in mechanical engineering" (2182735).

regular attendance: 22,5 hours
Lab: 22,5 hours (optional)
self-study: 75 hours

written exam 90 minutes

**Literature**

1. C++: Einführung und professionelle Programmierung; U. Breymann, Hanser Verlag München
2. C++ and object-oriented numeric computing for Scientists and Engineers, Daoqui Yang, Springer Verlag.
3. The C++ Programming Language, Bjarne Stroustrup, Addison-Wesley
4. Die C++ Standardbibliothek, S. Kuhlins und M. Schader, Springer Verlag

Numerik:

1. Numerical recipes in C++ / C / Fortran (90), Cambridge University Press
2. Numerische Mathematik, H.R. Schwarz, Teubner Stuttgart
3. Numerische Simulation in der Moleküldynamik, Griebel, Knapek, Zumbusch, Caglar, Springer Verlag

## V Exercises for Scientific Computing for Engineers

**Practice (Ü)**
**On-Site**

2181739, WS 24/25, 2 SWS, Language: German, Open in study portal

**Content**
Exercises for the different topics of the lecture "Scientific computing for Engineers" (2181738)

regular attendance: 22,5 hours

**Organizational issues**
Veranstaltungsort (RZ Pool Raum) wird in Vorlesung bekannt gegeben

**Literature**
Skript zur Vorlesung "Wissenschaftliches Programmieren für Ingenieure" (2181738)

# T 8.207 Course: Scientific Work and Empirical Research Methods [T-MACH-112930]

**Responsible:** Prof. Dr.-Ing. Barbara Deml
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102576 - Key Competencies

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

**Competence Certificate**
Ungraded written exam (pass/fail), duration 60 minutes. The written exam can be repeated as often as necessary until it is passed.

**Prerequisites**
none

# T 8.208 Course: Selected Problems of Applied Reactor Physics and Exercises [T-MACH-105462]

**Responsible:** apl. Prof. Dr. Ron Dagan
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2190411 | Selected Problems of Applied Reactor Physics and Exercises | 2 SWS | Lecture / 🗣 | Dagan, Metz |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105462 | Selected Problems of Applied Reactor Physics and Exercises | | | Dagan |
| WT 24/25 | 76-T-MACH-105462 | Selected Problems of Applied Reactor Physics and Exercises | | | Dagan, Metz |

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

**Competence Certificate**
oral exam, approx. 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 2024, 2 SWS, Language: German/English, Open in study portal

**Lecture (V) On-Site**

**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

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.

**Literature**

K. Wirtz Grundlagen der Reaktortechnik Teil I, II, Technische Hochschule Karlsruhe 1966

D. Emendorfer. K.H. Höcker Theorie der Kernreaktoren, BI- Hochschultaschenbücher 1969

J. Duderstadt and L. Hamilton, Nuclear reactor Analysis, J. Wiley $ Sons, Inc. 1975 (in English)

# T 8.209 Course: Self-Booking-BSc-HOC-SPZ-ZAK-Graded [T-MACH-111685]

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

**Part of:** M-MACH-102576 - Key Competencies

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Examination of another type | 2 | Grade to a third | Each term | 1 |

**Competence Certificate**
Completed coursework

**Prerequisites**
None

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

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

**Annotation**
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

# T 8.210 Course: Self-Booking-BSc-HOC-SPZ-ZAK-Non-Graded [T-MACH-111684]

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

**Part of:** M-MACH-102576 - Key Competencies

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

**Competence Certificate**
Completed coursework

**Prerequisites**
None

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

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

**Annotation**
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

# T 8.211 Course: Seminar for Rail System Technology [T-MACH-108692]

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

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Examination of another type | 3 | Grade to a third | Each term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2115009 | Seminar for Rail System Technology | 2 SWS | Seminar / 🗣 | Cichon, Ziesel |
| WT 24/25 | 2115009 | Seminar for Rail System Technology | 2 SWS | Seminar / 🗣 | Cichon, Ziesel |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-2115009 | Seminar for Rail System Technology | | | Cichon |
| WT 24/25 | 76-T-MACH-2115009 | Seminar for Rail System Technology | | | Cichon, Ziesel |

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

**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 2024, 2 SWS, Language: German, Open in study portal

**Seminar (S)**
**On-Site**

**Content**

1. Railway System: railway as a 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. System structure of railway vehicles: structure and major systems of rail vehicles
4. 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
5. 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 targets:

- The students become aware of the fundamental relations and interdependencies between rail vehicles, infrastructure and operation in a rail system.
- They overview the technical components of a rail system, in particular rail vehicle technology.
- They are able to use the essential elements of scientific work and present their results in written form and verbal presentation.

**Organizational issues**
Teilnehmerzahl ist auf 10 begrenzt. Die Einführungsveranstaltung findet am 08.05.2024 13.00-16.00 Uhr am Campus Ost, 70.04, R 008 statt. Die Prüfung besteht aus einer schriftlichen Ausarbeitung (Seminararbeit - ca. 20 Seiten Inhalt) und einem Vortrag über die Ausarbeitung. Weitere Infos siehe Institutshomepage https://www.fast.kit.edu/bst/929_11545.php.

Max. 10 participants. Examination: Writing a Seminararbeit (ca. 20 pages content), final presentation. Please check the homepage for further information.

**Literature**
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

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

V

## Seminar for Rail System Technology

2115009, WS 24/25, 2 SWS, Language: German, Open in study portal

**Seminar (S)**
**On-Site**

**Content**

1. Railway System: railway as a 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. System structure of railway vehicles: structure and major systems of rail vehicles
4. 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
5. 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 targets:

- The students become aware of the fundamental relations and interdependencies between rail vehicles, infrastructure and operation in a rail system.
- They overview the technical components of a rail system, in particular rail vehicle technology.
- They are able to use the essential elements of scientific work and present their results in written form and verbal presentation.

**Organizational issues**
Teilnehmerzahl ist auf 10 begrenzt. Die Einführungsveranstaltung findet am 13.11.2024 13.00-15.30 Uhr am Campus Ost, 70.04, R 008 statt. Die Prüfung besteht aus einer schriftlichen Ausarbeitung (Seminararbeit - ca. 20 Seiten Inhalt) und einem Vortrag über die Ausarbeitung. Weitere Infos siehe Institutshomepage https://www.fast.kit.edu/bst/929_11545.php.

Max. 10 participants. Examination: Writing a Seminararbeit (ca. 20 pages content), final presentation. Please check the homepage for further information.

**Literature**
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

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

# T 8.212 Course: Signals and Systems [T-ETIT-112860]

**Responsible:** Dr.-Ing. Mathias Kluwe
Prof. Dr.-Ing. Sander Wahls

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** M-MACH-102820 - Major Field: Mechatronics

| Type | Credits | Grading scale | Recurrence | Expansion | Version |
|---|---|---|---|---|---|
| Written examination | 7 | Grade to a third | Each winter term | 1 terms | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2302109 | Signals and Systems | 3 SWS | Lecture / | Wahls, Kluwe |
| WT 24/25 | 2302111 | Signals and Systems (Tutorial to 2302109) | 2 SWS | Practice / | Wahls, Leven, Illerhaus |
| **Exams** | | | | | |
| WT 24/25 | 7302109 | Signals and Systems | | | Wahls |

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

**Competence Certificate**
The assessment of success takes place in the form of a written examination lasting 180 minutes. The module grade is the grade of the written examination.

**Prerequisites**
none

# T 8.213 Course: Simulation of Coupled Systems [T-MACH-105172]

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

**Part of:** M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114095 | Simulation of Coupled Systems | 2 SWS | Lecture / 🗣 | Geimer, Breitfuß |
| **Exams** | | | | | |
| ST 2024 | 76T-MACH-105172 | Simulation of Coupled Systems | | | Geimer |
| WT 24/25 | 76T-MACH-105172 | Simulation of Coupled Systems | | | Geimer |

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

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

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

**Prerequisites**
Required for the participation in the examination is the preparation of a report during the semester. The partial service with the code T-MACH-108888 must have been passed.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-108888 - Simulation of Coupled Systems - Advance must have been passed.

**Recommendation**

- Knowledge of ProE (ideally in actual version)
- Basic kniwledge of Matlab/Simulink
- Basic knowledge of dynamics of machnies
- Basic knowledge of hydraulics

**Annotation**
After completion of course, students are able to:

- build a coupled simulation
- parametrize models
- perform simulations
- conduct troubleshooting
- check results for plausibility

The number of participants is limited.

**Content:**

- Basics of multi-body and hydralics simulation programs
- Possibilities of coupled simulations
- Modelling and Simulation of Mobile Machines using a wheel loader
- Documentation of the result in a short report

**Literature:**

Software guide books (PDFs)

Information about wheel-type loader specifications

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

V

**Simulation of Coupled Systems**
2114095, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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

It is recommended to have:

- Knowledge of ProE (ideally in current version)
- Basic knowledge of Matlab/Simulink
- Basic knowledge of dynamics of machines
- Basic knowledge of hydraulics

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

**Literature**
**Weiterführende Literatur:**

- Diverse Handbücher zu den Softwaretools in PDF-Form
- Informationen zum verwendeten Radlader

# T 8.214 Course: Simulation of Coupled Systems - Advance [T-MACH-108888]

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

**Part of:** M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 0 | pass/fail | Each summer term | 1 |

| Exams | | | |
|---|---|---|---|
| ST 2024 | 76-T-MACH-108888 | Simulation of Coupled Systems - Advance | Geimer |

**Competence Certificate**
Preparation of semester report

**Prerequisites**
none

# T 8.215 Course: Solar Thermal Energy Systems [T-MACH-106493]

**Responsible:** apl. Prof. Dr. Ron Dagan
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2189400 | Solar Thermal Energy Systems | 2 SWS | Lecture / 🗣 | Dagan |
| **Exams** | | | | | |
| ST 2024 | 76106493 | Repetition: Solar Thermal Energy Systems | | | Dagan |
| ST 2024 | 76-T-MACH-106493 | Solar Thermal Energy Systems | | | Dagan |
| WT 24/25 | 76-T-MACH-106493 | Solar Thermal Energy Systems | | | Dagan |

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

**Competence Certificate**
oral exam of about 30 minutes

**Prerequisites**
none

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105225 - Thermal Solar Energy must not have been started.

**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

2189400, WS 24/25, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

The course deals with fundamental aspects of solar energy

1. Introduction to solar energy – global energy panorama

2. Solar energy resource-

Structure of the sun, Black body radiation, solar constant, solar spectral distribution

Sun-Earth geometrical relationship

3. Passive and active solar thermal applications.

4. Solar thermal systems- solar collector-types, concentrating collectors, solar towers,

Heat losses, efficiency

5. Selected topics on thermodynamics and heat transfer which are relevant for solar systems.

6. Introduction to Solar induced systems: Wind , Heat pumps, Biomass , Photovoltaic

7. Energy storage

The course deals with fundamental aspects of solar energy. Starting from a global energy panorama the course deals with the sun as a thermal energy source. In this context, basic issues such as the sun's structure, blackbody radiation and solar–earth geometrical relationship are discussed. In the next part, the lectures cover passive and active thermal applications and review various solar collector types including concentrating collectors and solar towers and the concept of solar tracking. Further, the collector design parameters determination is elaborated, leading to improved efficiency. This topic is augmented by a review of the main laws of thermodynamics and relevant heat transfer mechanisms.

The course ends with an overview on energy storage concepts which enhance practically the benefits of solar thermal energy systems.

The students get familiar with the global energy demand and the role of renewable energies learn about improved designs for using efficiently the potential of solar energy gain basic understanding of the main thermal hydraulic phenomena which support the work on future innovative applications will be able to evaluate quantitatively various aspects of the thermal solar systems.

Total 120 h, hereof 30 h contact hours and 90 h homework and self-studies

oral exam about 30 min.

**Organizational issues**

Die Vorlesung "Thermische Solarenergie" findet ab dem WS 2024/25 nicht mehr statt. Sie wurde zusammengelegt mit der engl. Version "Solar Thermal Energy Systems"

**Literature**


- "Solar Engineering of Thermal Processes "4th Edition, J. Duffie &W. Beckman. Published by Wiley & Sons.
- "Heat Transfer", 10th Edition, P. Holman Mc. Graw Hill publisher.
- "Fundamentals of classical Thermodynamics", G. Van Wylen & R. E. Sonntag. Published by Wiley & Sons

# T 8.216 Course: Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example [T-MACH-110961]

**Responsible:** Bernd Grube
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102576 - Key Competencies

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2149663 | Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example | 2 SWS | Seminar / 🗣 | Grube |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-110961 | Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example | | | Grube |

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

**Competence Certificate**
alternative achievement (ungraded):
- attendance on at least 12 lecture units

**Prerequisites**
T-MACH-106375 – The Value Stream in an Industrial Company - The Value Chain at BOSCH as an Example must not have been startet.

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

## V Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example

**Seminar (S) On-Site**

2149663, WS 24/25, 2 SWS, Language: German, Open in study portal

**Content**
The lecture series provides an insight into the main functional areas of a global company and is based on close interaction with the students. Top managers from Bosch explain the technical and business processes of a company using examples from their business areas. The tasks of the engineer working at an innovative and globally active automotive supplier is addressed. These range from technical competence and an understanding of economic aspects to questions of personnel responsibility.

In addition, insights are provided into the careers of the Bosch managers giving the lectures. The focus of the course is therefore not only on business processes but also on first-hand accounts of challenges, successes, failures and product and process innovations.

The topics in detail are:

- Introduction, Strategy, Innovation
- R&D, Product Development Process
- Production
- Quality Assurance
- 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

**Organizational issues**
Die Anmeldung zum Seminar erfolgt über Ilias. (https://ilias.studium.kit.edu/)
Das Passwort wird im ersten Termin bekanntgegeben.

The registration for the seminar is via Ilias. (https://ilias.studium.kit.edu/)
The password will be announced in the first appointment.

**Literature**
Skript zur Veranstaltung wird über
(https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.217 Course: Strategic Product Development - Identification of Potentials of Innovative Products [T-MACH-105696]

**Responsible:** Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Prof. Dr.-Ing. Andreas Siebe

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 3 | Grade to a third | Each summer term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2146198 | Strategic product development - identification of potentials of innovative products | 2 SWS | Lecture / | Siebe |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105696 | Strategic product development - identification of potentials of innovative products | | | Siebe, Albers |

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

**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): Documentation and presentation of the overall 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

2146198, SS 2024, 2 SWS, Language: German, Open in study portal

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

**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.

**Organizational issues**
Anmeldung erforderlich; Termine/ Ort und weitere Informationen siehe IPEK-Homepage

# T 8.218 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
Prof. Dr.-Ing. Andreas Siebe

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Examination of another type | 1 | Grade to a third | Each summer term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2146198 | Strategic product development - identification of potentials of innovative products | 2 SWS | Lecture / 🧩 | Siebe |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-110396 | Strategic Product Development - Identification of Potentials of Innovative Products - Case Study | | | Siebe |

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

**Competence Certificate**
Successful processing of a case study(T-MACH-110396): documentation and presentation of the overall results (15 minutes)

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

## V Strategic product development - identification of potentials of innovative products

2146198, SS 2024, 2 SWS, Language: German, Open in study portal

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

**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.

**Organizational issues**
Anmeldung erforderlich; Termine/ Ort und weitere Informationen siehe IPEK-Homepage

# T 8.219 Course: Structural Analysis of Composite Laminates [T-MACH-105970]

**Responsible:** Prof. Dr.-Ing. Luise Kärger
**Organisation:** KIT Department of Mechanical Engineering
Lightweight Design
**Part of:** M-MACH-102746 - Compulsory Elective Module
M-MACH-102819 - Major Field: Materials Science and Engineering

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113106 | Structural Analysis of Composite Laminates | 2 SWS | Lecture / Practice ( / | Kärger |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105970 | Structural Analysis of Composite Laminates | | | Kärger |
| WT 24/25 | 76-T-MACH 105970 | Structural Analysis of Composite Laminates | | | Kärger |

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

**Competence Certificate**
oral exam, 20 min

**Prerequisites**
none

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

## V Structural Analysis of Composite Laminates

2113106, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**
To reduce fuel consumption and CO2 emissions, lightweight materials such as fiber-reinforced plasics (FRP) are increasingly being used in vehicle construction. The course is dedicated to the calculation of the material and structural behavior of FRP components with the following contents:

- Micromechanics and homogenization of fibre-matrix-composite
- Macromechanical behavior of individual layer
- Behaviour of multilayer laminate
- FE formulations
- Failure criteria
- Damage analysis
- Dimensioning of FRP parts

**Aim of this lecture:** The students can explain the mechanical correlation between fibre-matrix-configuration and macroscopic material behavior. They are able to formulate the stress-strain / force-strain relation of an individual layer and of a multilayer laminate by approaches of first and higher order. The students can name, evaluate, and apply failure criteria and approaches to model damage progression. They can name and explain simple dimension strategies to design FRP components.

**Literature**

H. Altenbach, J. Altenbach, and R. Rikards: Einführung in die Mechanik der Laminat- und Sandwichtragwerke. Deutscher Verlag für Grundstoffindustrie, Stuttgart, 1. edition, 1996.

Henning, F.; Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. Carl Hanser Verlag GmbH & Co. KG, 2011

A. Puck: Festigkeitsanalyse von Faser-Matrix-Laminaten, Modelle für die Praxis. Carl Hanser Verlag, München, Wien, 1. edition, 1996.

H. Schürmann: Konstruieren mit Faserverbundwerkstoffen. ISBN 3-540-40283-7. Springer Verlag, 2005.

**englischsprachige Literatur:**

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 8.220 Course: Sustainable Product Engineering [T-MACH-105358]

**Responsible:** Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr.-Ing. Karl-Friedrich Ziegahn

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102583 - Major Field: Information Management
M-MACH-102812 - Major Field: Powertrain Systems
M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102820 - Major Field: Mechatronics

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

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2146192 | Sustainable Product Engineering | 2 SWS | Lecture / 🗣 | Ziegahn |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105358 | Sustainable Product Engineering | | | Ziegahn, Albers |

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

**Competence Certificate**
written exam (90 min)

**Prerequisites**
none

**Recommendation**
None

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

## V Sustainable Product Engineering

2146192, SS 2024, 2 SWS, Open in study portal

**Lecture (V)**
**On-Site**

**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

The goal of the lecture is to convey the main elements of sustainable product development in the economic, social and ecological context.

The students are able to ...

- identify und describe the 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.
- discuss the skills for life-cycle product design using the example of complex automotive components such as airbag systems and other current products.
- understand the 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.
- develop skills such as team skills / project / self / presentation based on realistic projects.

# T 8.221 Course: Sustainable Production Economics [T-MACH-111859]

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

**Part of:** M-MACH-105902 - Sustainable Production Economics

| Type | Credits | Grading scale | Recurrence | Expansion | Version |
|---|---|---|---|---|---|
| Written examination | 5 | Grade to a third | Each winter term | 1 terms | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2149616 | Sustainable Production Economics | 4 SWS | Lecture / Practice ( / | Lanza |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-111859 | Sustainable Production Economics | | | Furmans, Lanza |
| WT 24/25 | 76-T-MACH-111859 | Sustainable Production Economics | | | Furmans, Lanza |

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

**Competence Certificate**
written exam (duration: 90 min)

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-100304 - Production Operations Management must not have been started.
2. The course T-MACH-108734 - Production Operations Management-Project must not have been started.

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

## V Sustainable Production Economics

2149616, WS 24/25, 4 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**
The lecture conveys an overall understanding of operational production management with special consideration of aspects of sustainability as well as an application-oriented understanding of the fundamental issues and methods in industrial companies. Through exercises as well as a business game synchronous to the lecture, the taught contents are deepened through application, so that the participants can apply them directly in their later professional environment.

**Learning Outcomes:**

After successful completion of the course, the students are able …

- to discuss, alone and in a team, the terms, contexts and models by which manufacturing companies are described;
- to discuss typical problems of manufacturing companies, especially against the background of current and future challenges of ecological, social and economic sustainability;
- to apply the most important methods for efficient and sustainable management in industrial enterprises, in particular in the sense of the circular economy, in a problem-related manner;
- to select and justify decision-making alternatives by applying the methods learned;
- to critically question the methods learned and to independently acquire methods that go beyond this.

**Workload:**

regular attendance: 42 hours
self-study: 108 hours

**Organizational issues**
Vorlesungstermine montags, Übungstermine freitags.
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung

**Literature**
**Medien:**
Skript zur Veranstaltung wird über ilias (https://ilias.studium.kit.edu/) bereitgestellt.

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

# T 8.222 Course: Sustainable Vehicle Drivetrains [T-MACH-111578]

**Responsible:** Prof. Dr. Thomas Koch
Dr.-Ing. Olaf Toedter

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques
M-MACH-102818 - Major Field: Vehicle Technology
M-MACH-102838 - Major Field: Energy Converting Engines

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

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2133132 | Sustainable Vehicle Drivetrains | 2 SWS | Lecture / 🗣 | Toedter |

Legend: 📱 Online, 🎛 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
oral exam (approx. 20 minutes)

**Prerequisites**
none

**Annotation**
Starting in winter term 25/26, the course consists of a lecture (2h / week) and a tutorial (1 h / week).

*Below you will find excerpts from events related to this course:*

## V Sustainable Vehicle Drivetrains

2133132, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Sustainability

Environmental balance

Legislation

Alternative fuels

BEV

Fuel cell

Hybrid drives

# T 8.223 Course: System Integration in Micro- and Nanotechnology [T-MACH-105555]

**Responsible:** apl. Prof. Dr. Ulrich Gengenbach
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102820 - Major Field: Mechatronics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2106033 | System Integration in Micro- and Nanotechnology I | 2 SWS | Lecture / 🗣 | Gengenbach |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105555 | System Integration in Micro- and Nanotechnology | | | Gengenbach |

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**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 I

2106033, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
**Content:**

- Introduction to system integration (fundamentals)
- Brief introduction to MEMS processes
- Flexures
- Surfaces and plasma processes for surface treatment
- Adhesive bonding in engineering
- Mounting techniques in electronics
- Molded Interconnect devices (MID)
- Functional Printing
- Low temperature cofired ceramics in system integration

**Learning objectives:**

The students acquire basic knowledge of challenges and system integration technologies from mechanical engineering, precision engineering and electronics.

**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 8.224 Course: System Integration in Micro- and Nanotechnology 2 [T-MACH-110272]

**Responsible:** apl. Prof. Dr. Ulrich Gengenbach
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102820 - Major Field: Mechatronics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2105040 | System Integration in Micro- and Nanotechnology 2 | 2 SWS | Lecture / 🗣 | Gengenbach |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-110272 | System Integration in Micro- and Nanotechnology 2 | | | Gengenbach |

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Oral exam, approx. 15 min.

**Prerequisites**
None

*Below you will find excerpts from events related to this course:*

## V System Integration in Micro- and Nanotechnology 2

2105040, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Introduction to system integration (novel processes and applications)

Assembly of hybrid microsystems

Packaging processes

Applications:

- Lab-on-chip systems
- Microoptical systems
- Silicon Photonics

Novel integration processes:

- Direct Laser Writing
- Self Assembly

**Learning objectives**
The students acquire knowledge of novel system integration technologies and their application in microoptic and microfluidic systems.

**Literature**
N.-T. Nguyen, Fundamentals and Applications of Microfluidics, Artech House

G. T. Reed, Silicon Photonics: An Introduction, Wiley

# T 8.225 Course: Systematic Materials Selection [T-MACH-100531]

**Responsible:** Dr.-Ing. Stefan Dietrich
Prof. Dr.-Ing. Volker Schulze

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102746 - Compulsory Elective Module

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 4 | Grade to a third | Each summer term | 5 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2174576 | Systematic Materials Selection | 3 SWS | Lecture / | Dietrich |
| ST 2024 | 2174577 | Excercises in Systematic Materials Selection | 1 SWS | Practice / | Dietrich |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-100531 | Systematic Materials Selection | | | Dietrich |
| WT 24/25 | 76-T-MACH-100531 | Systematic Materials Selection | | | Dietrich |

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

**Competence Certificate**
The assessment is carried out as a written exam of 2 h.

**Prerequisites**
M-MACH-102562 - Materials Science must be passed.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The module M-MACH-102562 - Materials Science must have been passed.

**Recommendation**
Basic knowledge in materials science, mechanics and mechanical design due to the lecture Materials Science I/II.

*Below you will find excerpts from events related to this course:*

## V Systematic Materials Selection

2174576, SS 2024, 3 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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

**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).

**Literature**
Vorlesungsskriptum; Übungsblätter; Lehrbuch: 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

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 8.226 Course: Technical Acoustics [T-MACH-111382]

**Responsible:** Dr. Iris Pantle
Johannes Walter

**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102816 - Major Field: Fundamentals of Energy Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2158107 | Technical Acoustics | 2 SWS | Lecture / 🗣 | Walter, Pantle |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-111382 | Technical Acoustics | | | Pantle, Walter |
| WT 24/25 | 76-T-MACH-111382 | Technical Acoustics | | | Pantle, Walter |

Legend: 🖥 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
oral exam, 30 min.

**Prerequisites**
None

*Below you will find excerpts from events related to this course:*

## V Technical Acoustics

2158107, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Basics of acoustics

Perception and weighting of noise (human hearing)

Description of acoustic parameters, level notation

Noise propagation

Acoustical measurement techniques

regular attendance: 28 hours
self-study: 60 hours

preparation for exam: 30 hours

Oral examination
Duration: 30 minutes
No tools or reference materials may be used during the exam.

WARNING for ETIT students: the recognition is not possible because the Faculty of Electrical Engineering and Information Technology also offers a "Technical Acoustics" course.

Students get to know the basics of technical acoustics in general. Application of the knowledge in different fields of engineering.

Students learn physical basics of acoustics and human perception. Physical-empirical laws for determination of sound and noise levels of various emission and immission situations will be worked out or derived. Furtheron general sound measurement methods of machinery will be taught.

Students are able to understand mechanisms of sound origin, propagation and reduction, as well as measuring technics

**Organizational issues**
Lehrveranstaltung findet in 14-tägigem Rhythmus statt. 1. Termin in 1. Vorlesungswoche.

**Literature**

1. Vorlesungsskript (über ILIAS erreichbar).
2. Heckl, M.; Müller, H. A.: Taschenbuch der Technischen Akustik, Springer-Verlag.
3. Veit, Ivar: Technische Akustik. Vogel-Verlag (Kamprath-Reihe), Würzburg.
4. Henn, H. et al.: Ingenieurakustik. Vieweg-Verlag.

# T 8.227 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-102815 - Major Field: Engineering Design

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 4 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2146179 | Technical Design in Product Development | 2 SWS | Lecture / ✕ | Schmid |

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

**Competence Certificate**
Written exam (60 min)

Only dictionnary is allowed

*Below you will find excerpts from events related to this course:*

## V Technical Design in Product Development

2146179, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Cancelled**

**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

Best Practice

After listening the module "technical design" the students should have knowledge about the basics of technical oriented design as an integral part of the methodical product development

The students have knowledge about ...

- the interface between engineer and designer.
- all relevant human-product requirements as f. exp. demographic/ geographic and psychographic features, relevant perceptions, typical content recognition as well as ergonomic bases.
- the approaches concerning the design of a product, product program or product system with focus on structure, form-, color- and graphic design within the phases of the design process.
- the design of functions and supporting structures as well as the important interface between human and machine.
- relevant parameters of a good corporate design.

**Organizational issues**
Die Veranstaltung **findet** 2024 **nicht statt**.

**Literature**

Markus Schmid, Thomas Maier
Technisches Interface Design
Anforderungen, Bewertung, Gestaltung.
Springer Vieweg Verlag (http://www.springer.com/de/book/9783662549476 )
Hardcover ISBN: 978-3-662-54947-6 / eBook ISBN: 978-3-662-54948-3
2017

Hartmut Seeger
Design technischer Produkte, Produktprogramme und -systeme
Industrial Design Engineering.
2. , bearb. und erweiterte Auflage.
Springer-Verlag GmbH (http://www.springer.com/de/book/9783540236535 )
ISBN: 3540236538
September 2005 - gebunden - 396 Seiten

# T 8.228 Course: Technical Thermodynamics and Heat Transfer I [T-MACH-104747]

**Responsible:** Prof. Dr. Ulrich Maas
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102574 - Technical Thermodynamics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 8 | Grade to a third | Each winter term | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 3165014 | Technical Thermodynamics and Heat Transfer I | 4 SWS | Lecture / 🗣 | Schießl, Maas |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-104747 | Technical Thermodynamics and Heat Transfer I | | | Maas, Schießl |
| ST 2024 | 76-T-MACH-104747-englisch | Technical Thermodynamics and Heat Transfer I | | | Maas, Schießl |
| WT 24/25 | 76-T-MACH-104747 | Technical Thermodynamics and Heat Transfer I | | | Maas, Schießl |
| WT 24/25 | 76-T-MACH-104747-english | Technical Thermodynamics and Heat Transfer I | | | Maas, Schießl |

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Written exam, approx. 3 hours

**Prerequisites**
Successful participation in the tutorial (T-MACH-105204 - Excercises in Technical Thermodynamics and Heat Transfer I)

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105204 - Excercises in Technical Thermodynamics and Heat Transfer I must have been passed.

*Below you will find excerpts from events related to this course:*

## V Technical Thermodynamics and Heat Transfer I

3165014, WS 24/25, 4 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- System, properties of state
- Absolute temperature, model systems
- 1st law of thermodynamics for resting and moving systems
- Entropy and 2nd law of thermodynamics
- Behavior of real substances described by tables, diagrams and equations of state
- Machine processes
- Mixtures of ideal and real compounds

**Literature**
Vorlesungsskriptum

Elsner, N.; Dittmann, A.: Energielehre und Stoffverhalten (Grundlagen der technischen Thermodynamik Bd. 1 und 2), 8. Aufl., Akademie-Verlag, 680 S. 1993.

Baehr, H.D.: Thermodynamik: eine Einführung in die Grundlagen und ihre technischen Anwendungen, 9. Aufl., Springer-Verlag, 460 S., 1996.

# T 8.229 Course: Technical Thermodynamics and Heat Transfer II [T-MACH-105287]

**Responsible:** Prof. Dr. Ulrich Maas
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102574 - Technical Thermodynamics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 7 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2166526 | Technical Thermodynamics and Heat Transfer II | 4 SWS | Lecture / 🗣 | Maas |
| ST 2024 | 3166526 | Technical Thermodynamics and Heat Transfer II | 4 SWS | Lecture / 🗣 | Schießl |
| WT 24/25 | 2100020 | Technical Thermodynamics and Heat Transfer II (Repeater Tutorial) | 2 SWS | Tutorial ( / 🗣 | Schießl |
| WT 24/25 | 2165530 | Technical Thermodynamics and Heat Transfer II (Repeater Tutorial) | 2 SWS | Practice / 🗣 | Maas |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105287 | Technical Thermodynamics and Heat Transfer II | | | Maas, Schießl |
| ST 2024 | 76-T-MACH-105287-englisch | Technical Thermodynamics and Heat Transfer II | | | Maas, Schießl |
| WT 24/25 | 76-T-MACH-105287 | Technical Thermodynamics and Heat Transfer II | | | Maas, Schießl |
| WT 24/25 | 76-T-MACH-105287-english | Technical Thermodynamics and Heat Transfer II | | | Maas, Schießl |

Legend: 🖥 Online, 🖥🗣 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Written exam, approx. 3 hours

**Prerequisites**
Successful participation in the tutorial (T-MACH-105288 - Exercises in Technical Thermodynamics and Heat Transfer II)

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-105288 - Excercises in Technical Thermodynamics and Heat Transfer II must have been passed.

*Below you will find excerpts from events related to this course:*

## V Technical Thermodynamics and Heat Transfer II

2166526, SS 2024, 4 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

- Repetition of the topics of "Thermodynamics and Heat Transfer I"
- Behavior of mixtures
- Moist air
- Kinetic theory of gases
- Behavior of real substances described by equations of state
- Chemical reactions and applications of the laws of thermodynamics to chemical reactions
- Reaction kinetics
- Heat Transfer

**Literature**
Vorlesungsskriptum

Elsner, N.; Dittmann, A.: Energielehre und Stoffverhalten (Grundlagen der technischen Thermodynamik Bd. 1 und 2), 8. Aufl., Akademie-Verlag, 680 S. 1993.

Baehr, H.D.: Thermodynamik: eine Einführung in die Grundlagen und ihre technischen Anwendungen, 9. Aufl., Springer-Verlag, 460 S., 1996.

### V Technical Thermodynamics and Heat Transfer II

**Lecture (V)**
**On-Site**

3166526, SS 2024, 4 SWS, Language: English, Open in study portal

**Content**

- Repetition of the topics of "Thermodynamics and Heat Transfer I"
- Behavior of mixtures
- Moist air
- Kinetic theory of gases
- Behavior of real substances described by equations of state
- Chemical reactions and applications of the laws of thermodynamics to chemical reactions
- Reaction kinetics
- Heat Transfer

**Literature**
Vorlesungsskriptum

Elsner, N.; Dittmann, A.: Energielehre und Stoffverhalten (Grundlagen der technischen Thermodynamik Bd. 1 und 2), 8. Aufl., Akademie-Verlag, 680 S. 1993.

Baehr, H.D.: Thermodynamik: eine Einführung in die Grundlagen und ihre technischen Anwendungen, 9. Aufl., Springer-Verlag, 460 S., 1996.

### V Technical Thermodynamics and Heat Transfer II (Repeater Tutorial)

**Practice (Ü)**
**On-Site**

2165530, WS 24/25, 2 SWS, Language: German, Open in study portal

**Literature**
Vorlesungsskriptum
Elsner, N.; Dittmann, A.: Energielehre und Stoffverhalten (Grundlagen der technischen Thermodynamik Bd. 1 und 2), 8. Aufl., Akademie-Verlag, 680 S. 1993.
Baehr, H.D.: Thermodynamik: eine Einführung in die Grundlagen und ihre technischen Anwendungen, 9. Aufl., Springer-Verlag, 460 S., 1996.

# T 8.230 Course: Technology of Steel Components [T-MACH-105362]

**Responsible:** Prof. Dr.-Ing. Volker Schulze
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each summer term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2174579 | Technology of steel components | 2 SWS | Lecture / 🗣 | Schulze |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105362 | Technology of Steel Components | | | Schulze |
| WT 24/25 | 76-T-MACH-105362 | Technology of Steel Components | | | Schulze |

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Oral exam, about 25 minutes

**Prerequisites**
M-MACH-102562 - Materials Science must be passed.

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The module M-MACH-102562 - Materials Science must have been passed.

*Below you will find excerpts from events related to this course:*

## V Technology of steel components

2174579, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Meaning, Development and characterization of component states
Description of the influence of component state on mechanical properties
Stability of component states
Steel manufacturing
Component states due to forming
Component states due to heat treatments
Component states due to surface hardening
Component states due to machining
Component states due to mechanical surface treatments
Component states due to joining
Summarizing evaluation

**learning objectives:**
The students have the background to evaluate the influence of manufacture processes on the compound state of metallic compounds. The students can assess the influence and the stability of compound state under mechanical load. The students are capable to describe the individual aspects of interaction of the compound state of steel components due to forming, heat treatment, mechanical surface treatment and joining processes.
**requirements:**
Materials Science and Engineering I & II
**workload:**

regular attendance: 21 hours
self-study: 99 hours

**Literature**
Skript wird in der Vorlesung ausgegeben

VDEh: Werkstoffkunde Stahl, Bd. 1: Grundlagen, Springer-Verlag, 1984

H.-J. Eckstein: Technologie der Wärmebehandlung von Stahl, Deutscher Verlag Grundstoffindustrie, 1977

H.K.D.H. Badeshia, R.W.K. Honeycombe, Steels - Microstructure and Properties, CIMA Publishing, 3. Auflage, 2006

V. Schulze: Modern Mechanical Surface Treatments, Wiley, Weinheim, 2005

# T 8.231 Course: Theory of Stability [T-MACH-105372]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102820 - Major Field: Mechatronics
M-MACH-104442 - Major Field: Vibration Theory

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 6 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2163113 | Theory of Stability | 2 SWS | Lecture / ✕ | Fidlin |
| ST 2024 | 2163114 | Übungen zu Stabilitätstheorie | 2 SWS | Practice / ✕ | Fidlin, Yüzbasioglu |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105372 | Theory of Stability | | | Fidlin |

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

**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 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Cancelled**

**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

**Organizational issues**
Die Vorlesung Stabilitätstheorie wird im Sommersemester 2024 nicht angeboten.

**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 8.232 Course: Thermal Solar Energy [T-MACH-105225]

**Responsible:** apl. Prof. Dr. Ron Dagan
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each winter term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2189400 | Solar Thermal Energy Systems | 2 SWS | Lecture / 🗣 | Dagan |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105225 | Thermal Solar Energy | | | Dagan |
| WT 24/25 | 76-T-MACH-106493 | Solar Thermal Energy Systems | | | Dagan |

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Oral examination of about 30 minutes

**Prerequisites**
none

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-106493 - Solar Thermal Energy Systems must not have been started.

*Below you will find excerpts from events related to this course:*

## V Solar Thermal Energy Systems

2189400, WS 24/25, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**

The course deals with fundamental aspects of solar energy

1. Introduction to solar energy – global energy panorama

2. Solar energy resource-

Structure of the sun, Black body radiation, solar constant, solar spectral distribution

Sun-Earth geometrical relationship

3. Passive and active solar thermal applications.

4. Solar thermal systems- solar collector-types, concentrating collectors, solar towers,

Heat losses, efficiency

5. Selected topics on thermodynamics and heat transfer which are relevant for solar systems.

6. Introduction to Solar induced systems: Wind , Heat pumps, Biomass , Photovoltaic

7. Energy storage

The course deals with fundamental aspects of solar energy. Starting from a global energy panorama the course deals with the sun as a thermal energy source. In this context, basic issues such as the sun's structure, blackbody radiation and solar–earth geometrical relationship are discussed. In the next part, the lectures cover passive and active thermal applications and review various solar collector types including concentrating collectors and solar towers and the concept of solar tracking. Further, the collector design parameters determination is elaborated, leading to improved efficiency. This topic is augmented by a review of the main laws of thermodynamics and relevant heat transfer mechanisms.

The course ends with an overview on energy storage concepts which enhance practically the benefits of solar thermal energy systems.

The students get familiar with the global energy demand and the role of renewable energies learn about improved designs for using efficiently the potential of solar energy gain basic understanding of the main thermal hydraulic phenomena which support the work on future innovative applications will be able to evaluate quantitatively various aspects of the thermal solar systems.

Total 120 h, hereof 30 h contact hours and 90 h homework and self-studies

oral exam about 30 min.

**Organizational issues**

Die Vorlesung "Thermische Solarenergie" findet ab dem WS 2024/25 nicht mehr statt. Sie wurde zusammengelegt mit der engl. Version "Solar Thermal Energy Systems"

**Literature**


- "Solar Engineering of Thermal Processes "4th Edition, J. Duffie &W. Beckman. Published by Wiley & Sons.
- "Heat Transfer", 10th Edition, P. Holman Mc. Graw Hill publisher.
- "Fundamentals of classical Thermodynamics", G. Van Wylen & R. E. Sonntag. Published by Wiley & Sons

# T 8.233 Course: Thermal Turbomachines I [T-MACH-105363]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
**Part of:** M-MACH-102838 - Major Field: Energy Converting Engines

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 6 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2169453 | Thermal Turbomachines I | 3 SWS | Lecture / 🗣 | Bauer |
| WT 24/25 | 2169454 | Tutorial - Thermal Turbo Machines I | 2 SWS | Practice / 🗣 | Bauer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105363 | Thermal Turbomachines I | | | Bauer |
| ST 2024 | 76T-Mach-105363-Wdh | Thermal Turbomachines I (for repeater) | | | Bauer |
| WT 24/25 | 76-T-MACH-105363 | Thermal Turbomachines I | | | Bauer |
| WT 24/25 | 76-T-MACH-105363-Wdh | Thermal Turbomachines I (for repeaters) | | | Bauer |

Legend: 🖥 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

**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 24/25, 3 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to to describe and analyse not only the individual components but also entire assemblies. The students can asses and evaluate the effects of physical, economical and ecological boundary conditions.

regular attendance: 31,50 h
self-study: 64,40 h

**Recommendations:**

Recommended in combination with the lecture 'Thermal Turbomachines II'.

Examination:

oral
Duration: approximately 30 min

no tools or reference materials may be used during the exam

**Organizational issues**
Vorlesung wird nur noch in Englisch gehalten ab WS 2023/24.

Aufzeichnungen in Deutsch aus früheren Vorlesungen werden weiter zur Verfügung gestellt.

**Literature**
Vorlesungsskript (erhältlich im Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

# T 8.234 Course: Thermal Turbomachines II [T-MACH-105364]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
**Part of:** M-MACH-102838 - Major Field: Energy Converting Engines

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 6 | Grade to a third | Each summer term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2170477 | Tutorial - Thermal Turbomachines II (Übung - Thermische Turbomaschinen II) | 2 SWS | Practice / 🗣 | Bauer, Mitarbeiter |
| ST 2024 | 2170553 | Thermal Turbomachines II (in English) | 3 SWS | Lecture / 🗣 | Bauer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105364 | Thermal Turbomachines II | | | Bauer |
| ST 2024 | 76T-Mach-105364-Wdh | Thermal Turbomachines II (for repeaters) | | | Bauer |
| WT 24/25 | 76-T-MACH-105364 | Thermal Turbomachines II | | | Bauer |
| WT 24/25 | 76-T-MACH-105364-Wdh | Thermal Turbomachines II (for repeaters) | | | Bauer |

Legend: 🖥 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
oral exam, duration: 30 min.

**Prerequisites**
none

*Below you will find excerpts from events related to this course:*

## V Thermal Turbomachines II (in English)

2170553, SS 2024, 3 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

**Recommendations:**

Recommended in combination with the lecture 'Thermal Turbomachines II'.

regular attendance: 31,50 h
self-study: 64,40 h

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to to describe and analyse not only the individual components but also entire assemblies. The students can asses and evaluate the effects of physical, economical and ecological boundary conditions.

Exam:

oral

Duration: approximately 30 min

no tools or reference materials may be used during the exam.

**Literature**
Vorlesungsskript (erhältlich im Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

# T 8.235 Course: Tires and Wheel Development for Passenger Cars [T-MACH-102207]

**Responsible:** Prof. Dr.-Ing. Günter Leister
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102818 - Major Field: Vehicle Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2114845 | Tires and Wheel Development for Passenger Cars | 2 SWS | Lecture / 🗣 | Leister |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102207 | Tires and Wheel Development for Passenger Cars | | | Leister |
| WT 24/25 | 76-T-MACH-102207 | Tires and Wheel Development for Passenger Cars | | | Leister |

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**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 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**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

Learning Objectives:

The students are informed about the interactions of tires, wheels and chassis. They have an overview of the processes regarding the tire and wheel development. They have knowledge of the physical relationships.

**Organizational issues**
Voraussichtliche Termine, nähere Informationen und eventuelle Terminänderungen:

siehe Institutshomepage.

**Literature**
Manuskript zur Vorlesung

Manuscript to the lecture

# T 8.236 Course: Tools for HPC and AI in Engineering [T-MACH-113265]

**Responsible:** Dr.-Ing. Samuel Braun
**Organisation:** KIT Department of Mechanical Engineering
**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2133120 | Tools for HPC and AI in Engineering | 2 SWS | Lecture / 🗣 | Braun |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-113265 | Tools for HPC and AI in Engineering | | | Koch |
| WT 24/25 | 76-T-MACH-113265 | Tools for HPC and AI in Engineering | | | Braun |

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
oral exam, 20 min.

**Prerequisites**
none

*Below you will find excerpts from events related to this course:*

## V Tools for HPC and AI in Engineering

2133120, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
The lecture covers the basics of the tools necessary to work in the fields of artificial intelligence and high performance computing.

In particular, the framework conditions and the infrastructure provided by KIT will also be addressed.

The following topics and issues will be covered:

- Hardware and operating system
  Which (relevant) components does a computer have? How can AI applications be executed with different operating systems (Windows, MacOS, Linux)? How can supercomputers be accessed from different operating systems?
- Command line
  What is the command line and why does it (still) exist? What possibilities do the different operating systems offer to access the command line? Which shells exist and which are typical on HPC facilities? What are the basic commands to get around on a supercomputer?
- Remote Access
  How to access a supercomputer, what are the types of authentication? How do you set up SSH keys and what forms of 2-factor authentication are common? How does a file transfer between supercomputer and local computer work?
- Supercomputers and HPC
  How is a supercomputer different from regular PCs? Which HPC resources does KIT offer? How are they accessed and what are the special features of the KIT infrastructure compared to other systems? What infrastructure is available statewide and nationally, for what purposes? How must software be designed to be compatible with supercomputers?
- Version Control
  What is it and why is it needed? What code hosting services exist? How does one access the Gitlab instance operated by KIT? What CI/CD capabilities exist at KIT?
- Editors
  How to edit program code, locally or remotely? What are the possibilities of Visual Studio Code to debug AI applications or HPC workflows on KIT supercomputers? How to develop code with code-server on compute nodes? How can documentation be done? What is the current state of pair programming with AI?
- Python and Jupyter
  Which Python distributions exist? Which ones are suitable for KIT HPC resources? How can Python packages be installed and used? What are Virtual Environments and what are they needed for? How can machine learning applications be developed with Jupyter, locally and remotely?
- Machine Learning
  What are the typical software packages needed for AI applications? How are they installed and used? What is a typical workflow to develop/use ML applications? What are accelerators, what specialized hardware does KIT infrastructure have?
- Remote Visualization
  How to use graphical applications on remote computers? What are the possibilities of remote visualization? Using Paraview as an example, how can a flow simulation be graphically evaluated interactively/non-interactively?
- Special topics
  What are containers and virtual machines? What are the benefits of containers especially for Machine Learning applications? Which container solutions can be used on KIT supercomputers? What is WSL 2? Which (commercial) cloud services exist for HPC and AI? Which cloud services are available at KIT for free?

Learning objectives
A major learning goal of the lecture is to provide an overview of available and suitable software tools (editors, access options, version management, infrastructure (at KIT)) for HPC and AI. Any existing fear of contact with the Linux operating system and the seemingly complex use of supercomputers will be eliminated. After successful attendance of the lecture, the students will be able to work on theses that touch on the topics of Artificial Intelligence or High Performance Computing.

Performance assessment
Oral exam: 30 min

# T 8.237 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-102812 - Major Field: Powertrain Systems

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 8 | Grade to a third | Each winter term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2181114 | Tribology | 5 SWS | Lecture / Practice ( / | Dienwiebel, Scherge |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-105531 | Tribology | | | Dienwiebel |

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

**Competence Certificate**
oral examination (ca. 40 min)

no tools or reference materials

**Prerequisites**
admission to the exam only with successful completion of the exercises [T-MACH-109303]

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-MACH-109303 - Exercices - Tribology must have been passed.

**Recommendation**
preliminary knowlegde in mathematics, mechanics and materials science

*Below you will find excerpts from events related to this course:*

## V Tribology

2181114, WS 24/25, 5 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**
**On-Site**

**Content**

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, evironmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems
- evaluate the friction and wear behavior of tribological systems
- explain the effects of lubricants and their most important additives
- identify suitable approaches to optimize tribological systems
- explain the most important experimental methods for the measurement of friction and wear, and is able to use them for the characterisation of tribo pairs
- choose suitable methods for the evaluation of roughness and topography from the nm-scale to the mm-scale and is able to interpret the determined values in respect to their effect on the tribological behavior
- describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces

preliminary knowlegde in mathematics, mechanics and materials science recommended

regular attendance: 45 hours
self-study: 195 hours

oral examination (ca. 40 min)

no tools or reference materials

admission to the exam only with successful completion of the exercises

**Literature**

1. Fleischer, G. ; Gröger, H. ; Thum: Verschleiß und Zuverlässigkeit. 1. Auflage. Berlin : VEB-Verlag Technik, 1980
2. Persson, B.J.N.: Sliding Friction, Springer Verlag Berlin, 1998
3. M. Dienwiebel, and M. Scherge, Nanotribology in automotive industry, In:Fundamentals of Friction and Wear on the Nanoscale; Editors: E. Meyer and E. Gnecco, Springer, Berlin, 2007.
4. Scherge, M., Shakhvorostov, D., Pöhlmann, K.: Fundamental wear mechanism of metals. Wear 255, 395–400 (2003)
5. Shakhvorostov, D., Pöhlmann, K., Scherge, M.: An energetic approach to friction, wear and temperature. Wear 257, 124–130 (2004)

# T 8.238 Course: Turbo Charging of Internal Combustion Engines [T-MACH-111591]

**Responsible:** Dr.-Ing. Johannes Kech
Dr.-Ing. Heiko Kubach

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102645 - Major Field: Combustion Engine Techniques
M-MACH-102838 - Major Field: Energy Converting Engines

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each summer term | 1 |

| Exams | | | |
|---|---|---|---|
| ST 2024 | 76-T-MACH-105649 | Boosting of Combustion Engines | Koch |

**Competence Certificate**
oral exam, appr. 20 min

**Prerequisites**
none

# T 8.239 Course: Turbo Jet Engines [T-MACH-105366]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
**Part of:** M-MACH-102838 - Major Field: Energy Converting Engines

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2170478 | Turbo Jet Engines | 2 SWS | Lecture / 🗣 | Bauer |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105366 | Turbo Jet Engines | | | Bauer |
| WT 24/25 | 76-T-MACH-105366 | Turbo Jet Engines | | | Bauer |

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

**Competence Certificate**
oral exam, duration: 20 min.

**Prerequisites**
none

*Below you will find excerpts from events related to this course:*

## V Turbo Jet Engines

2170478, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Introduction to jet engines and their components

Demands on engines and propulsive efficiency

Thermodynamic and gas dynamic fundamentals and design calculations

Components of air breathing engines

Jet engine design and development process

Engine and component design

Current developments in the jet engines industry

The students have the ability to:

- compare the design concepts of modern jet engines
- analyse the operation of modern jet engines
- apply the thermodynamic and fluidmechanic basics of jet engines
- choose the main components intake, compressor, combustor, turbine and thrust nozzle based on given criteria
- comment on different methods for the reduction of pollutant emissions, noise and fuel consumption

regular attendance:21 h
self-study: 42 h

Exam:

oral
Duration: approximately 30 minutes

no tools or reference materials may be used during the exam

**Literature**

Hagen, H.: Fluggasturbinen und ihre Leistungen, G. Braun Verlag, 1982
Hünnecke, K.: Flugtriebwerke, ihre Technik und Funktion, Motorbuch Verlag, 1993
Saravanamuttoo, H.; Rogers, G.; Cohen, H.: Gas Turbine Theory, 5th Ed., 04/2001
Rolls-Royce: The Jet Engine, ISBN:0902121235, 2005

# T 8.240 Course: Tutorial Advanced Mathematics I [T-MATH-100525]

**Responsible:** PD Dr. Tilo Arens
Prof. Dr. Roland Griesmaier
PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102859 - Advanced Mathematics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (written) | 0 | pass/fail | Each winter term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 0131100 | Übungen zu 0131000 | 2 SWS | Practice | Hettlich |
| WT 24/25 | 0131300 | Übungen zu 0131200 | 2 SWS | Practice | Hettlich |

**Competence Certificate**
Learning assessment is carried out by written assigments (pre-requesite). Exact requirements will be communicated in the lectures.

**Prerequisites**
None.

# T 8.241 Course: Tutorial Advanced Mathematics II [T-MATH-100526]

**Responsible:** PD Dr. Tilo Arens
Prof. Dr. Roland Griesmaier
PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102859 - Advanced Mathematics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (written) | 0 | pass/fail | Each summer term | 2 |

| **Events** | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 0180900 | Übungen zu 0180800 | 2 SWS | Practice | Arens |
| ST 2024 | 0181100 | Übungen zu 0181000 | 2 SWS | Practice | Arens |
| **Exams** | | | | | |
| ST 2024 | 7700024 | Problem Class for Advanced Mathematics II | | | Hettlich, Arens, Griesmaier |

**Competence Certificate**
Learning assessment is carried out by written assigments (pre-requesite). Exact requirements will be communicated in the lectures.

**Prerequisites**
None.

# T 8.242 Course: Tutorial Advanced Mathematics III [T-MATH-100527]

**Responsible:** PD Dr. Tilo Arens
Prof. Dr. Roland Griesmaier
PD Dr. Frank Hettlich

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102859 - Advanced Mathematics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (written) | 0 | pass/fail | Each winter term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 0131500 | Übungen zu 0131400 | 2 SWS | Practice | Griesmaier |

**Competence Certificate**
Learning assessment is carried out by written assigments (pre-requesite). Exact requirements will be communicated in the lectures.

**Prerequisites**
None.

# T 8.243 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-102582 - Major Field: Continuum Mechanics
M-MACH-102746 - Compulsory Elective Module

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 1 | pass/fail | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2161253 | Tutorial Continuum mechanics of solids and fluids | 2 SWS | Practice / 🗣 | Gisy, Speichinger, Böhlke |

Legend: 🖳 Online, 🖳🗣 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**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 (BSc) that have chosen the Major Field "Continuum Mechanics" and for students of Material Science and Material Technology (BSc) the prerequisites consist of successfully solving the written homework sheets as well as the computational homework sheets during the associated computer tutorials.

For students of Mechanical Engineering that have chosen a different Major Field of students from different fields of study the prerequisites consist of successfully solving only the written homework sheets.

**Prerequisites**
None

**Annotation**
Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) and students of the bachelor's degree program in material science and material technology will be admitted to the computer tutorials in any case.
If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

*Below you will find excerpts from events related to this course:*

## V Tutorial Continuum mechanics of solids and fluids

2161253, WS 24/25, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Please refer to the lecture "Continuum mechanics of solids and fluids".

**Literature**
Siehe Vorlesung " Kontinuumsmechanik der Festkörper und Fluide ".

Please refer to the lecture "Continuum mechanics of solids and fluids".

# T 8.244 Course: Tutorial Engineering Mechanics I [T-MACH-100528]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke
Dr.-Ing. Tom-Alexander Langhoff

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102572 - Engineering Mechanics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 0 | pass/fail | Each winter term | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2161246 | Tutorial Engineering Mechanics I | 2 SWS | Practice / 🗣 | Klein, Lauff, Böhlke |
| WT 24/25 | 3161011 | Engineering Mechanics I (Tutorial) | 2 SWS | Practice / 🗣 | Gisy, Lalović, Langhoff |

Legend: 🖥 Online, 🖥🗣 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Successful solution of worksheets. Details are given in the first lecture "Engineering Mechanics I"

Passing this course allows to register to the exam "Engineering Mechanics I" (see T-MACH-100282).

**Prerequisites**
None

*Below you will find excerpts from events related to this course:*

## V Tutorial Engineering Mechanics I

2161246, WS 24/25, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Please refer to the lecture Engineering Mechanics I.

**Literature**
Siehe Vorlesung Technische Mechanik I

## V Engineering Mechanics I (Tutorial)

3161011, WS 24/25, 2 SWS, Language: English, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
See Lecture "Engineering Mechanics I"

**Literature**
See Lecture "Engineering Mechanics I"

# T 8.245 Course: Tutorial Engineering Mechanics II [T-MACH-100284]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke
Dr.-Ing. Tom-Alexander Langhoff

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102572 - Engineering Mechanics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (written) | 0 | pass/fail | Each summer term | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162251 | Tutorial Engineering Mechanics II | 2 SWS | Practice / 🗣 | Kehrer, Klein, Böhlke |
| ST 2024 | 3162011 | Engineering Mechanics II (Tutorial) | 2 SWS | Practice / 🗣 | Langhoff, Gisy, Klein |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-100284 | Tutorial Engineering Mechanics II | | | Böhlke, Langhoff |
| ST 2024 | 76-T-MACH-100284-englisch | Tutorial Engineering Mechanics II | | | Böhlke, Langhoff |

Legend: 🖥 Online, 🖥🗣 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Successful solution of worksheets. Details are given in the first lecture "Engineering Mechanics II"

Passing this course allows to register to the exam "Engineering Mechanics II" (see T-MACH-100283).

**Prerequisites**
None

*Below you will find excerpts from events related to this course:*

## V Tutorial Engineering Mechanics II

2162251, SS 2024, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
see lecture Engineering Mechanics II

**Literature**
Siehe Vorlesung Technische Mechanik II

## V Engineering Mechanics II (Tutorial)

3162011, SS 2024, 2 SWS, Language: English, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
see lecture "Engineering Mechanics II"

**Literature**
see lecture "Engineering Mechanics II"

# T 8.246 Course: Tutorial Engineering Mechanics III [T-MACH-105202]

**Responsible:** Prof. Dr.-Ing. Carsten Proppe
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102572 - Engineering Mechanics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (written) | 0 | pass/fail | Each winter term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2161204 | Engineering Mechanics III (Tutorial) | 2 SWS | Practice / 🗣 | Proppe, Fischer, Kaupp |
| WT 24/25 | 3161013 | Engineering Mechanics III (Tutorial) | 2 SWS | Practice / 🗣 | Fidlin, Altoé |

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Attestations, succesful accomplishment of exercise sheets

**Prerequisites**
None

*Below you will find excerpts from events related to this course:*

## V Engineering Mechanics III (Tutorial)

2161204, WS 24/25, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
In the Tutorial excercises for the corresponding subjects of the lecture are presented. During the tutorial part of the tutorial excercises are presented and instructions for those excercises are given which have to be done as homework.

The homework is mandatory and is corrected by the tutors. A successful elaboration of the homework is necessary to take part in the final exam.

**Literature**
Hibbeler: Technische Mechanik 3, Dynamik, München, 2006

Gross, Hauger, Schnell: Technische Mechanik Bd. 3, Heidelberg, 1983

Lehmann: Elemente der Mechanik III, Kinetik, Braunschweig, 1975

Göldner, Holzweissig: Leitfaden der Technischen Mechanik.

Hagedorn: Technische Mechanik III.

## V Engineering Mechanics III (Tutorial)

3161013, WS 24/25, 2 SWS, Language: English, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
Exercises related to the lecture

# T 8.247 Course: Tutorial Engineering Mechanics IV [T-MACH-105203]

**Responsible:** N.N.
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102572 - Engineering Mechanics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework (written) | 0 | pass/fail | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162232 | Engineering Mechanics IV (Tutorial) | 2 SWS | Practice / 🗣 | Proppe, Kaupp, Singhal |
| ST 2024 | 3162013 | Engineering Mechanics 4 (Tutorial) | 2 SWS | Practice / 🗣 | Römer, Kaupp, Singhal |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105203 | Tutorial Engineering Mechanics IV | | | Proppe |

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

**Competence Certificate**
Attestations, succesful accomplishment of exercise sheets

*Below you will find excerpts from events related to this course:*

## V Engineering Mechanics IV (Tutorial)

2162232, SS 2024, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
In the Tutorial excercises for the corresponding subjects of the lecture are presented. During the tutorial part of the excercises are presented and instructions are given for those excercises which have to be done as homework.

The homework is mandatory and is corrected by the tutors. A successful elaboration of the homework is necessary to take part in the final exam.

**Literature**
Hibbeler: Technische Mechanik 3, Dynamik, München, 2006
Marguerre: Technische Mechanik III, Heidelberger Taschenbücher, 1968
Magnus: Kreisel, Theorie und Anwendung, Springer-Verlag, Berlin,
1971 Klotter: Technische Schwingungslehre, 1. Bd. Teil A, Heidelberg

# T 8.248 Course: Tutorial Introduction to Computational Fluid Dynamics [T-MACH-111033]

**Responsible:** Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Alexander Stroh

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102582 - Major Field: Continuum Mechanics
M-MACH-102746 - Compulsory Elective Module

| Type | Credits | Grading scale | Recurrence | Expansion | Version |
|---|---|---|---|---|---|
| Completed coursework | 1 | pass/fail | Each summer term | 1 terms | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2154534 | Tutorial Introduction to Computational Fluid Dynamics | 2 SWS | Practice / 🧩 | Stroh, Frohnapfel |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-111033 | Tutorial Introduction to Computational Fluid Dynamics | | | Stroh |

Legend: 💻 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
The competence certificate consists of successfully solving the computational homework tasks.

**Prerequisites**
none

**Annotation**
Successful participation in this course allows for registration to the Exam: "Introduction to Computational Fluid Dynamics" (see T-MACH-110362).

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 is expected.

*Below you will find excerpts from events related to this course:*

## V Tutorial Introduction to Computational Fluid Dynamics

2154534, SS 2024, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**Blended (On-Site/Online)**

**Content**

- Introduction and Motivation, Fundamental Equations and Dimensionless Numbers
- Turblence and Modelling (DNS, LES, RANS);
- Numerical Solution of the Navier Stokes Equations:
  Discretization and Solution Approaches (FDM, FVM), boundary and initial conditions, stability, mistakes in numerics and modelling
- Set-up of a numerical simulation: pre- and postprocessing, validation, result evaluation, discussion of results
- Introduction to open-source toolbox OpenFOAM:
  set-up of simulation, generation of numerical grid with different tools, data evaluation within OpenFOAM and with python;
- Introduction to a research oriented toolbox for turbulent flows (DNS based o Incompact3d): set-up of simulation, statistical evaluation and analysis with MATLAB und python;
- visualisization of simulation results in ParaView

This course includes a lecture and a computer course. The limited places in the computer course will be distributed by the institute.

# T 8.249 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-102582 - Major Field: Continuum Mechanics
M-MACH-102746 - Compulsory Elective Module

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 1 | pass/fail | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2162257 | Tutorial Introduction to the Finite Element Method | 1 SWS | Practice / 🗣 | Lauff, Langhoff, Böhlke, Klein |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-110330 | Tutorial Introduction to the Finite Element Method | | | Böhlke, Langhoff |

Legend: 🖥 Online, 🖥🗣 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Successful participation in this course allows for registration to the Exam "Introduction to the Finite Element Method" (see 76-T-MACH-105320)

For students of Mechanical Engineering (BSc) that have chosen the Major Field "Continuum Mechanics" the prerequisites consist of successfully solving the written homework sheets as well as the computational homework sheets during the associated computer tutorials.

For students of Mechanical Engineering that have chosen a different Major Field and for students from different fields of study the prerequisites consist of successfully solving only the written homework sheets.

**Annotation**
Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected.

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) will be admitted to the computer tutorials in any case.
If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

*Below you will find excerpts from events related to this course:*

## V Tutorial Introduction to the Finite Element Method

2162257, SS 2024, 1 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
See lecture "Introduction to the Finite Element Method"

**Literature**
siehe Vorlesung "Einführung in die Finite-Elemente-Methode"

# T 8.250 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-102746 - Compulsory Elective Module

| Type | Credits | Grading scale | Recurrence | Expansion | Version |
|---|---|---|---|---|---|
| Completed coursework | 2 | pass/fail | Each winter term | 1 terms | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2161255 | Tutorial Mathematical Methods in Confinuum Mechanics | 2 SWS | Practice / 🗣 | Lauff, Klein, Böhlke |

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

**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

2161255, WS 24/25, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**
**On-Site**

**Content**
See "Mathematical Methods in Continuum Mechanics"

**Literature**
Siehe "Mathematische Methoden der Kontinuumsmechanik"

# T 8.251 Course: Vehicle Ergonomics [T-MACH-108374]

**Responsible:** Sofie Ehrhardt
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102815 - Major Field: Engineering Design
M-MACH-102818 - Major Field: Vehicle Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 4 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2110050 | Vehicle Ergonomics | 3 SWS | Lecture / 🗣 | Ehrhardt |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-108374 | Vehicle Ergonomics | | | Ehrhardt |

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
written exam, 60 minutes

**Prerequisites**
none

*Below you will find excerpts from events related to this course:*

## V Vehicle Ergonomics

2110050, SS 2024, 3 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
- 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 and thus enables effective, efficient and satisfying interaction. After attending the lecture, students are able to analyse and evaluate the ergonomic quality of various vehicle concepts and derive design recommendations. They can consider aspects of both physical and cognitive ergonomics. Students are familiar with basic ergonomic methods, theories and concepts as well as with theories of human information processing, especially theories of driver behaviour. They are capable of critically reflecting this knowledge and applying it in a flexible way within the user-centered design process.

**Organizational issues**
Die Vorlesung hat einen Arbeitsaufwand von 120 h (= 4 LP).

Im SS 2024 sind es noch 2 SWS.
Ab dem SS 2025 sind es 3 SWS.

**Literature**
Die Literaturliste wird in der Vorlesung ausgegeben. Die Folien zur Vorlesung stehen auf ILIAS zum Download zur Verfügung.

# T 8.252 Course: Vehicle Lightweight Design - Strategies, Concepts, Materials [T-MACH-105237]

**Responsible:** Prof. Dr.-Ing. Frank Henning
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Lightweight Design
M-MACH-102638 - Major Field: Rail System Technology
M-MACH-102818 - Major Field: Vehicle Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 4 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2113102 | Vehicle Lightweight design – Strategies, Concepts, Materials | 2 SWS | Lecture / | Henning |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105237 | Vehicle Lightweight Design - Strategies, Concepts, Materials | | | Henning |
| WT 24/25 | 76-T-MACH-105237 | Vehicle Lightweight Design - Strategies, Concepts, Materials | | | Henning |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**
Written exam; Duration approx. 90 min

**Prerequisites**
none

**Recommendation**
none

*Below you will find excerpts from events related to this course:*

## V Vehicle Lightweight design – Strategies, Concepts, Materials

2113102, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**Blended (On-Site/Online)**

**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
Steel, aluminium, magnesium, titan

**Aim of this lecture:**

Students learn that lightweight design is a process of realizing a demanded function by using the smallest possible mass. They understand lightweight construction as a complex optimization problem with multiple boundary conditions, involving competences from methods, materials and production.

Students learn the established lightweight strategies and ways of construction. They know the metallic materials used in lightweight construction and understand the relation between material and vehicle body.

**Literature**

[1] E. Moeller, *Handbuch Konstruktionswerkstoffe : Auswahl, Eigenschaften, Anwendung*. München: Hanser, 2008.

[2] H.-J. Bargel*, et al.*, *Werkstoffkunde*, 10., bearb. Aufl. ed. Berlin: Springer, 2008.

[3] C. Kammer, *Aluminium-Taschenbuch : Grundlagen und Werkstoffe*, 16. Aufl. ed. Düsseldorf: Aluminium-Verl., 2002.

[4] K. U. Kainer, "Magnesium - Eigenschaften, Anwendungen, Potentiale ", Weinheim [u.a.], 2000, pp. VIII, 320 S.

[5] A. Beck and H. Altwicker, *Magnesium und seine Legierungen*, 2. Aufl., Nachdr. d. Ausg. 1939 ed. Berlin: Springer, 2001.

[6] M. Peters, *Titan und Titanlegierungen*, [3., völlig neu bearb. Aufl.] ed. Weinheim [u.a.]: Wiley-VCH, 2002.

[7] H. Domininghaus and P. Elsner, *Kunststoffe : Eigenschaften und Anwendungen; 240 Tab*, 7., neu bearb. u. erw. Aufl. ed. Berlin: Springer, 2008.

# T 8.253 Course: Vehicle Systems for Urban Mobility [T-MACH-113069]

**Responsible:** Prof. Dr.-Ing. Martin Cichon
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102638 - Major Field: Rail System Technology

| Type | Credits | Grading scale | Version |
|---|---|---|---|
| Oral examination | 4 | Grade to a third | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2115922 | Vehicle Systems for Urban Mobility | 2 SWS | Lecture / 🗣 | Cichon, Berthold |
| WT 24/25 | 2115922 | Vehicle Systems for Urban Mobility | 2 SWS | Lecture / 🗣 | Cichon, Ziesel |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-106428 | Vehicle Systems for Urban Mobility | | | Cichon, Berthold |
| WT 24/25 | 76-T-MACH-106428 | Vehicle Systems for Urban Mobility | | | Ziesel, Cichon |

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Oral examination
Duration: approx. 20 minutes
No tools or reference material may be used during the exam.

# T 8.254 Course: Vibration Theory [T-MACH-105290]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102746 - Compulsory Elective Module
M-MACH-102820 - Major Field: Mechatronics
M-MACH-104430 - Major Field: Modeling and Simulation in Dynamics
M-MACH-104442 - Major Field: Vibration Theory

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 5 | Grade to a third | Each winter term | 3 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2161212 | Vibration Theory | 2 SWS | Lecture / 🗣 | Genda |
| WT 24/25 | 2161213 | Übungen zu Technische Schwingungslehre | 2 SWS | Practice | Keller |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105290 | Vibration Theory | | | Fidlin |

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
written exam, 180 min.

**Prerequisites**
none

*Below you will find excerpts from events related to this course:*

## V Vibration Theory

2161212, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Concept of vibration, superposition of vibration with equal and with different frequencies, complex frequency response.

Vibration of systems with one dof: Free undamped and damped vibration, forced vibration for harmonic, periodic and arbitrary excitation. Excitation of undamped vibration in resonance.

Systems with many degrees of freedom: Eigenvalue problem for undamped vibration, orthogonality of eigenvectors, modal decoupling, approximation methods, eigenvalue problem for damped vibration. Forced vibration for harmonic excitation, modal decomposition for arbitrary forced vibration, vibration absorber.

Vibration of systems with distributed parameters: Partial differential equations as equations of motion, wave propagation, d'Alembert's solution, Ansatz for separation of time and space, eigenvalue problem, infinite number of eigenvalues and eigenfunctions.

Introduction to rotor dynamics: Laval rotor in rigid and elastic bearings, inner damping, Laval rotor in anisotropic bearings, synchronous and asynchronous whirl, rotors with asymmetric shaft.

**Literature**
Klotter: Technische Schwingungslehre, Bd. 1 Teil A, Heidelberg, 1978

Hagedorn, Otterbein: Technische Schwingungslehre, Bd. 1 und Bd. 2, Berlin, 1987

Wittenburg: Schwingungslehre, Springer-Verlag, Berlin, 1995

## V Übungen zu Technische Schwingungslehre

2161213, WS 24/25, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**

**Content**
Exercises related to the lecture

# T 8.255 Course: Virtual Engineering (Specific Topics) [T-MACH-105381]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102746 - Compulsory Elective Module

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 3122031 | Virtual Engineering (Specific Topics) | 2 SWS | Lecture / 🗣 | Ovtcharova, Maier |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105381 | Virtual Engineering (Specific Topics) | | | Ovtcharova |

Legend: 💻 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
oral exam, approx. 20 min.

**Prerequisites**
none

*Below you will find excerpts from events related to this course:*

## V Virtual Engineering (Specific Topics)

3122031, SS 2024, 2 SWS, Language: English, Open in study portal

**Lecture (V)**
**On-Site**

**Content**
Students can

- explain the basics of virtual engineering and name exemplary modeling tools and assign them to the corresponding methods and processes
- Formulate validation questions in the product development process and name obvious solution methods
- explain the basics of systems engineering and establish the connection to the product development process
- explain individual methods of the digital factory and present the functions of the digital factory in the context of the product creation process
  explain the theoretical and technical basics of Virtual Reality technology and show the connection to Virtual Engineering

**Organizational issues**
Zeit und Ort der Lehrveranstaltung siehe ILIAS / Time and place of the course see ILIAS.

**Literature**
Lecture slides / Vorlesungsfolien

# T 8.256 Course: Virtual Reality Practical Course [T-MACH-102149]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102583 - Major Field: Information Management
M-MACH-102820 - Major Field: Mechatronics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Examination of another type | 4 | Grade to a third | Each term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2123375 | Virtual Reality Practical Course | 3 SWS | Project (P / 🗣 | Ovtcharova, Häfner |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-102149 | Virtual Reality Practical Course | | | Ovtcharova, Häfner |

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**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

2123375, WS 24/25, 3 SWS, Language: German/English, Open in study portal

**Project (PRO)**
**On-Site**

**Content**

- Introduction in Virtual Reality (hardware, software, applications)
- Exercises in the task specific software systems
- Autonomous project work in the area of Virtual Reality in small groups

**Literature**
Keine / None

# T 8.257 Course: Warehousing and Distribution Systems [T-MACH-105174]

**Responsible:** Prof. Dr.-Ing. Kai Furmans
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102821 - Major Field: Technical Logistics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 3 | Grade to a third | Each summer term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2118097 | Warehousing and distribution systems | 2 SWS | Lecture / 🗣 | Furmans |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105174 | Warehousing and Distribution Systems | | | Furmans |

Legend: 💻 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

**Prerequisites**
none

*Below you will find excerpts from events related to this course:*

## V Warehousing and distribution systems

2118097, SS 2024, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

**Organizational issues**
Die Vorlesung wird in diesem Semester als **Blockveranstaltung** angeboten. Die Veranstaltungstermine sind:

- Mi., 24. April
- Do., 25. April
- Fr., 26. April

Die Vorlesung startet jeweils um 08:00 Uhr und findet im **Selmayr-HS (Geb. 50.38)** statt. Bitte beachten Sie für mögliche kurzfristige Raumänderungen die Informationen im ILIAS-Kurs.

**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

Eine ausführliche Übersicht wissenschaftlicher Paper findet sich bei:

**ROODBERGEN, Kees Jan (2007)**
Warehouse Literature

# T 8.258 Course: Wave and Quantum Physics [T-PHYS-108322]

**Responsible:** apl. Prof. Dr. Gernot Goll
apl. Prof. Dr. Bernd Pilawa
**Organisation:** KIT Department of Physics
**Part of:** M-PHYS-104030 - Physics

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 5 | Grade to a third | Each summer term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 4040411 | Wellen und Quantenphysik | 2 SWS | Lecture / 🗣 | Pilawa |
| ST 2024 | 4040412 | Übungen zu Wellen und Quantenphysik | 1 SWS | Practice / 🗣 | Pilawa, Palkhivala |
| ST 2024 | 4040431 | Wave and Quantum Physics | 2 SWS | Lecture / 🗣 | Goll |
| ST 2024 | 4040432 | Exercises to Wave and Quantum Physics | 1 SWS | Practice / 🗣 | Goll, Jobbitt |
| **Exams** | | | | | |
| ST 2024 | 7800123 | Wellen und Quantenphysik (Exam in German) | | | Pilawa |
| ST 2024 | 7800124 | Wave and Quantum Physics (Exam in English) | | | Goll |

Legend: 🖥 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Written exam (usually about 180 min)

**Prerequisites**
none

# T 8.259 Course: Welding Technology [T-MACH-105170]

**Responsible:** Dr. Majid Farajian
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102819 - Major Field: Materials Science and Engineering

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Oral examination | 4 | Grade to a third | Each winter term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2173571 | Welding Technology | 2 SWS | Block / 🗣 | Farajian |

Legend: 💻 Online, 🎛 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
Oral exam, about 20 minutes

**Prerequisites**
none

**Recommendation**
Basics of material science (iron- and non-iron alloys), materials, processes and production, design.

All the relevant books of the German Welding Institute (DVS: Deutscher Verband für Schweißen und verwandte Verfahren) in the field of welding and joining is recommended.

*Below you will find excerpts from events related to this course:*

## V Welding Technology

2173571, WS 24/25, 2 SWS, Language: German, Open in study portal

**Block (B)**
**On-Site**

**Content**
definition, application and differentiation: welding,

welding processes, alternative connecting technologies.

history of welding technology

sources of energy for welding processes

Survey: Fusion welding,

pressure welding.

weld seam preparation/design

welding positions

weldability

gas welding, thermal cutting, manual metal-arc welding

submerged arc welding

gas-shielded metal-arc welding, friction stir welding, laser beam and electron beam welding, other fusion and pressure welding processes

static and cyclic behavior of welded joints,

fatigue life improvement techniques

**learning objectives:**

The students have knowledge and understanding of the most important welding processes and its industrial application.

They are able to recognize, understand and handle problems occurring during the application of different welding processes relating to design, material and production.

They know the classification and the importance of welding technology within the scope of connecting processes (advantages/ disadvantages, alternatives).

The students will understand the influence of weld quality on the performance and behavior of welded joints under static and cyclic load.

How the fatigue life of welded joints could be increased, will be part of the course.

**requirements:**
basics of material science ( iron- and non-iron alloys), of electrical engineering, of production processes.

**workload:**

The workload for the lecture Welding Technology is 120 h per semester and consists of the presence during the lecture (18 h) as well as preparation and rework time at home (102 h).

**exam:**

oral, ca. 20 minutes, no auxiliary material

**Organizational issues**
Blockveranstaltung im Januar und Februar. Zur Teilnahme an der Vorlesung ist eine Anmeldung beim Dozenten per E-Mail an Farajian@slv-duisburg.de erforderlich. Vorlesungstermine und Hörsaal werden den angemeldeten Teilnehmern Anfang des Jahres mitgeteilt.

**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 8.260 Course: Windpower [T-MACH-105234]

**Responsible:** Norbert Lewald
**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology
M-MACH-102838 - Major Field: Energy Converting Engines

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Written examination | 4 | Grade to a third | Each winter term | 2 |

| Events | | | | | |
|---|---|---|---|---|---|
| WT 24/25 | 2157381 | Windpower | 2 SWS | Lecture / 🗣 | Lewald |
| **Exams** | | | | | |
| ST 2024 | 76-T-MACH-105234 | Windpower | | | Lewald |
| WT 24/25 | 76-T-MACH-105234 | Windpower | | | Lewald |

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

**Competence Certificate**
written exam, 120 minutes

**Prerequisites**
none

*Below you will find excerpts from events related to this course:*

## V Windpower

2157381, WS 24/25, 2 SWS, Language: German, Open in study portal

**Lecture (V)**
**On-Site**

# T 8.261 Course: Workshop on Computer-based Flow Measurement Techniques [T-MACH-106707]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer
**Organisation:** KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
**Part of:** M-MACH-102816 - Major Field: Fundamentals of Energy Technology

| Type | Credits | Grading scale | Recurrence | Version |
|---|---|---|---|---|
| Completed coursework | 4 | pass/fail | Each term | 1 |

| Events | | | | | |
|---|---|---|---|---|---|
| ST 2024 | 2171488 | Workshop on computer-based flow measurement techniques | 3 SWS | Practical course / 🗣 | Bauer, Mitarbeiter |
| WT 24/25 | 2171488 | Workshop on computer-based flow measurement techniques | 3 SWS | Practical course / 🗣 | Bauer, Mitarbeiter |
| **Exams** | | | | | |
| WT 24/25 | 76-T-MACH-106707 | Workshop on computer-based flow measurement techniques | | | Bauer |

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

**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 2024, 3 SWS, Language: German, Open in study portal

**Practical course (P)**
**On-Site**

**Content**
Registration during the lecture period via the website.

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
-

regular attendance: 52,5
self-study: 67,5

The students are able to:

- theoretically describe and explain the fundamentals of computer aided measurements and and adopt them practically
- apply the basics learned during the lecture to a practical problem in the form of a PC excercise

Group colloquia for each topic

Duration: approximately 10 minutes

no tools or reference materials may be used

**Organizational issues**
Der aktuelle Status wird auf der ITS-homepage bekannt gegeben.

**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 24/25, 3 SWS, Language: German, Open in study portal **On-Site**

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