

Module Handbook Mechatronics and Information Technology Master 2015 (Master of Science (M.Sc.))

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KIT DEPARTMENT OF MECHANICAL ENGINEERING / KIT DEPARTMENT OF ELECTRICAL ENGINEERING AND INFORMATION TECHNOLOGY



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7.117. Integrated Product Development - T-MACH-105401	426
7.118. Integrated Systems and Circuits - T-ETIT-100972	427
7.119. Intellectual Property Rights and Strategies in Industrial Companies - T-MACH-105442	428
7.120. International Production Engineering A - T-MACH-110334	429
7.121. International Production Engineering B - T-MACH-110335	430
7.122. Introduction to Energy Economics - T-WIWI-102746	431
7.123. Introduction to Microsystem Technology I - T-MACH-105182	432
7.124. Introduction to Microsystem Technology II - T-MACH-105183	433
7.125. Introduction to Multi-Body Dynamics - T-MACH-105209	434
7.126. Introduction to the Scientific Method (Seminar, German) - T-ETIT-111316	435
7.127. IoT Platform for Engineering - T-MACH-106743	436
7.128. IT-Fundamentals of Logistics - T-MACH-105187	437
7.129. Lab Computer-Aided Methods for Measurement and Control - T-MACH-105341	438
7.130. Lab Course Electrical Drives and Power Electronics - T-ETIT-100718	439
7.131. Lab Course Electrical Power Engineering - T-ETIT-100728	440
7.132. Lab Course on Nanoelectronics - T-ETIT-100757	441
7.133. Laboratory Biomedical Engineering - T-ETIT-101934	442
7.134. Laboratory Digital Signal Processing - T-ETIT-101935	443
7.135. Laboratory FPGA Based Circuit Design - T-ETIT-100759	444
7.136. Laboratory Information Systems in Power Engineering - T-ETIT-100727	445
7.137. Laboratory Mechatronic Measurement Systems - T-ETIT-106854	446
7.138. Laboratory Mechatronics - T-MACH-105370	447
7.139. Laboratory Nanotechnology - T-ETIT-100765	448
7.140. Laboratory Optoelectronics - T-ETIT-100764	449
7.141. Laboratory Solar Energy - T-ETIT-104686	450
7.142. Leadership in Interdisciplinary Teams - T-MACH-106460	451
7.143. Lighting Engineering - T-ETIT-100772	452
7.144. Lightweight Engineering Design - T-MACH-105221	453
7.145. Localization of Mobile Agents - T-INFO-101377	454
7.146. Logistics and Supply Chain Management - T-MACH-110771	455
7.147. Machine Dynamics - T-MACH-105210	456
7.148. Machine Learning - Foundations and Algorithms - T-INFO-111558	457
7.149. Machine Learning 1 - Basic Methods - T-WIWI-106340	458
7.150. Machine Learning 2 – Advanced Methods - T-WIWI-106341	459
7.151. Machine Tools and High-Precision Manufacturing Systems - T-MACH-110962	460
7.152. Machine Vision - T-MACH-105223	461
7.153. Manufacturing Measurement Technology - T-ETIT-106057	462
7.154. Master's Thesis - T-ETIT-106463	463
7.155. Material Flow in Logistic Systems - T-MACH-102151	464
7.156. Materials of Lightweight Construction - T-MACH-105211	465
7.157. Mathematical Methods in Continuum Mechanics - T-MACH-110375	466
7.158. Measurement Technology - T-ETIT-112147	467
7.159. Mechanics in Microtechnology - T-MACH-105334	468
7.160. Mechano-Informatics and Robotics - T-INFO-101294	469
7.161. Medical Imaging Techniques I - T-ETIT-101930	470
7.162. Medical Imaging Techniques II - T-ETIT-101931	471
7.163. Methods and Processes of PGE - Product Generation Engineering - T-MACH-109192	472

7.164. Methods of Signal Processing - T-ETIT-100694	473
7.165. Microactuators - T-MACH-101910	474
7.166. Microenergy Technologies - T-MACH-105557	475
7.167. Microsystem Simulation - T-MACH-108383	476
7.168. Microsystem Technology - T-ETIT-100752	477
7.169. Microwave Engineering - T-ETIT-100802	478
7.170. Microwave Engineering Lab - T-ETIT-110789	479
7.171. Microwaves Measurement Techniques - T-ETIT-100733	480
7.172. Modern Control Concepts I - T-MACH-105539	481
7.173. Modern Control Concepts II - T-MACH-106691	482
7.174. Modern Control Concepts III - T-MACH-106692	483
7.175. Modern Radio Systems Engineering - T-ETIT-100735	484
7.176. Motion in Human and Machine - Seminar - T-INFO-105140	485
7.177. Motor Vehicle Labor - T-MACH-105222	486
7.178. Nano- and Quantum Electronics - T-ETIT-111232	487
7.179. Nonlinear Control Systems - T-ETIT-100980	488
7.180. Nonlinear Optics - T-ETIT-101906	489
7.181. Novel Actuators and Sensors - T-MACH-102152	490
7.182. Numerical Methods - Exam - T-MATH-111700	491
7.183. Optical Communications Laboratory - T-ETIT-100742	492
7.184. Optical Design Lab - T-ETIT-100756	493
7.185. Optical Transmitters and Receivers - T-ETIT-100639	494
7.186. Optical Waveguides and Fibers - T-ETIT-101945	495
7.187. Optimal Control and Estimation - T-ETIT-104594	496
7.188. Optimization of Dynamic Systems - T-ETIT-100685	497
7.189. Optoelectronic Measurement Engineering - T-ETIT-100771	498
7.190. Optoelectronics - T-ETIT-100767	499
7.191. Oral Exam - Supplementary Studies on Culture and Society - T-ZAK-112659	500
7.192. Oral Exam - Supplementary Studies on Sustainable Development - T-ZAK-112351	501
7.193. Organ Support Systems - T-MACH-105228	502
7.194. Pattern Recognition - T-INFO-101362	503
7.195. Photovoltaics - T-ETIT-101939	504
7.196. Physical and Data-Based Modelling - T-ETIT-111013	505
7.197. Physiology and Anatomy for Biomedical Engineering - T-ETIT-111815	506
7.198. Plasma Sources - T-ETIT-100768	507
7.199. Plastic Electronics / Polymerelectronics - T-ETIT-100763	508
7.200. PLM for Product Development in Mechatronics - T-MACH-102181	509
7.201. Plug-and-Play Material Handling - T-MACH-106693	510
7.202. Power Electronic Systems in Energy Technology - T-ETIT-112286	511
7.203. Power Electronics - T-ETIT-109360	512
7.204. Power Electronics for Photovoltaics and Wind Energy - T-ETIT-104569	513
7.205. Power Network - T-ETIT-100830	514
7.206. Power Systems and Economy - T-ETIT-100725	515
7.207. Power Transmission and Power Network Control - T-ETIT-101941	516
7.208. Practical Aspects of Electrical Drives - T-ETIT-100711	517
7.209. Practical Course: Machine Learning and Intelligent Systems - T-INFO-112104	518
7.210. Practical Course: Smart Energy System Lab - T-INFO-112030	519
7.211. Practical Project Robotics and Automation I (Software) - T-INFO-104545	520
7.212. Practical Project Robotics and Automation II (Hardware) - T-INFO-104552	521
7.213. Practical Training in Basics of Microsystem Technology - T-MACH-102164	522
7.214. Practice Module - T-ZAK-112660	523
7.215. Principles of Medicine for Engineers - T-MACH-105235	524
7.216. Production Techniques Laboratory - T-MACH-105346	525
7.217. Project Management in the Development of Products for Safety-Critical Applications - T-ETIT-109148	526
7.218. ProVIL - Product Development in a Virtual Idea Laboratory - T-MACH-106738	527
7.219. Quality Management - T-MACH-102107	528
7.220. Rail System Technology - T-MACH-106424	529
7.221. Rail Vehicle Technology - T-MACH-105353	530
7.222. Real Time Control of Electrical Drives - T-ETIT-111898	531
7.223. Real-Time Systems - T-INFO-101340	532

7.224. Reinforcement Learning - T-INFO-111255	533
7.225. Reliability and Test Engineering - T-MACH-111840	534
7.226. Renewable Energy-Resources, Technologies and Economics - T-WIWI-100806	535
7.227. Robotics - Practical Course - T-INFO-105107	536
7.228. Robotics I - Introduction to Robotics - T-INFO-108014	537
7.229. Robotics II - Humanoid Robotics - T-INFO-105723	538
7.230. Robotics III - Sensors and Perception in Robotics - T-INFO-109931	539
7.231. Seamless Engineering - T-MACH-111401	540
7.232. Self Assignment-HOC-SPZ-ZAK-graded - T-ETIT-111527	541
7.233. Self Assignment-HOC-SPZ-ZAK-graded - T-ETIT-111526	542
7.234. Self Assignment-HOC-SPZ-ZAK-graded - T-ETIT-111528	543
7.235. Self Assignment-HOC-SPZ-ZAK-ungraded - T-ETIT-111531	544
7.236. Self Assignment-HOC-SPZ-ZAK-ungraded - T-ETIT-111530	545
7.237. Self Assignment-HOC-SPZ-ZAK-ungraded - T-ETIT-111532	546
7.238. Seminar Accessibility - Assistive Technologies for Visually Impaired Persons - T-INFO-104742	547
7.239. Seminar Application of Artificial Intelligence in Production - T-MACH-112121	548
7.240. Seminar Creating a Patent Specification - T-ETIT-100754	549
7.241. Seminar Data-Mining in Production - T-MACH-108737	550
7.242. Seminar Embedded Systems - T-ETIT-100753	551
7.243. Seminar for Rail System Technology - T-MACH-108692	552
7.244. Seminar Intelligent Industrial Robots - T-INFO-104526	553
7.245. Seminar Novel Concepts for Solar Energy Harvesting - T-ETIT-108344	554
7.246. Seminar on Quantum Detectors and Sensors - T-ETIT-111235	555
7.247. Seminar Project Management for Engineers - T-ETIT-108820	556
7.248. Seminar Project Management for Engineers - T-ETIT-100814	557
7.249. Seminar Radar and Communication Systems - T-ETIT-100736	558
7.250. Seminar: Energy Informatics - T-INFO-106270	559
7.251. Sensors - T-ETIT-101911	560
7.252. SIL Entrepreneurship Project - T-WIWI-110166	561
7.253. Software Engineering - T-ETIT-108347	562
7.254. Solar Energy - T-ETIT-100774	563
7.255. Spaceborne Radar Remote Sensing - T-ETIT-106056	564
7.256. Specialisation Module - Self Assignment BeNe - T-ZAK-112346	565
7.257. Stochastic Information Processing - T-INFO-101366	566
7.258. Strategy Derivation for Engineers - T-ETIT-111369	567
7.259. System Integration in Micro- and Nanotechnology - T-MACH-105555	568
7.260. System Integration in Micro- and Nanotechnology 2 - T-MACH-110272	569
7.261. Systematic Materials Selection - T-MACH-100531	570
7.262. System-on-Chip Laboratory - T-ETIT-100798	571
7.263. Systems and Software Engineering - T-ETIT-100675	572
7.264. Technical Design in Product Development - T-MACH-105361	573
7.265. Technical Optics - T-ETIT-100804	574
7.266. Thermal Solar Energy - T-MACH-105225	575
7.267. Tutorial Continuum Mechanics of Solids and Fluids - T-MACH-110333	576
7.268. Tutorial Mathematical Methods in Continuum Mechanics - T-MACH-110376	577
7.269. Ubiquitous Computing - T-INFO-101326	578
7.270. Ultrasound Imaging - T-ETIT-100822	579
7.271. Vehicle Lightweight Design - Strategies, Concepts, Materials - T-MACH-105237	580
7.272. Virtual Engineering I - T-MACH-102123	581
7.273. Virtual Engineering Lab - T-MACH-106740	582
7.274. Virtual Solution Methods and Processes - T-MACH-111285	583
7.275. Virtual Training Factory 4.X - T-MACH-106741	584
7.276. Wearable Robotic Technologies - T-INFO-106557	585

1. Description of the degree program

1.1. List of abbreviations

Departments:	ETIT	KIT Department of Electrical Engineering and Information Technology <i>KIT-Fakultät für Elektrotechnik und Informationstechnik</i>
	MACH	KIT Department of Mechanical Engineering <i>KIT-Fakultät für Maschinenbau</i>
	INFO	KIT Department of Informatics <i>KIT-Fakultät für Informatik</i>
	CIW	KIT Department of Chemical and Process Engineering <i>KIT-Fakultät für Chemieingenieurwesen und Verfahrenstechnik</i>
	PHYS	KIT Department of Physics <i>KIT-Fakultät für Physik</i>
	WIWI	Department of Economics and Management <i>KIT-Fakultät für Wirtschaftswissenschaften</i>
Semester:	WS	winter term (<i>Wintersemester</i>)
	SS	summer term (<i>Sommersemester</i>)
Achievements:	V	Lecture (<i>Vorlesung</i>)
	Ü	Exercise (<i>Übung</i>)
	P	Laboratory (<i>Praktikum</i>)
	CR	Credit Points (<i>Leistungspunkte</i>)
	Pr	Examination (<i>Prüfung</i>)
Miscellaneous:	B.Sc.	Degree program (<i>Studiengang</i>) Bachelor of Science
	M.Sc.	Degree program (<i>Studiengang</i>) Master of Science
	SPO	Study and examination regulations (<i>Studien- und Prüfungsordnung</i>)
	SWS	contact hours per week (<i>Semesterwochenstunden</i>)

1.2. Subjects

The legal basis for the degree program and the conduct of examinations are the currently valid Study and Examination Regulations (Studien- und Prüfungsordnung, SPO) (<https://www.mach.kit.edu/Master-MIT.php?tab=%5B3687%5D#tabpanel-3687>).

The program degree M.Sc. Mechatronics and Information Technology consists of the following subjects, which are explained in more detail in this chapter. A detailed list of the corresponding modules can be found in the chapter “Structure of degree program”.

- General Mechatronics: 32 CR
- Field of Specialization: 35 CR
- Interdisciplinary Subject: 17 CR
- Interdisciplinary Qualifications: 6 CR
- Master’s Thesis: 30 CR

In total: 120 CR

General Mechatronics

This subject consists of compulsory modules that must be completed by the students. In the modules “Technische Mechanik” and “Werkstoffe” there are elective options.

Field of Specialization

Students choose a Field of Specialization from the following list. Each field includes 35 credit points:

- Automotive Engineering (*Fahrzeugtechnik*)
- Power Engineering (*Energietechnik*)
- Microsystems Technology (*Mikrosystemtechnik*)
- Medical Technology (*Medizintechnik*)
- Industrial Automation (*Industrieautomation*)
- Control Engineering in Mechatronics (*Regelungstechnik in der Mechatronik*)
- Robotics (*Robotik*)
- Design of Mechatronic Systems (*Konstruktion Mechatronischer Systeme*)

In addition to the compulsory modules, each Field of Specialization contains supplementary modules, which can be compiled from the list of courses given. The minimum number of 35 credit points required for the Field of Specialization must be achieved (or can be exceeded once). If necessary, several modules from the list of selectable supplementary modules must be combined.

The list of supplementary modules may be subject to adjustments resulting from the departure of teaching staff, the reorganization of courses and other circumstances. Therefore, the module list in the module handbook is adjusted to current conditions before each semester. In principle, students can choose all supplementary modules for their study plan that are included in the recent module handbook. Omitted modules cannot be started any more. If they have already been taken, they will of course remain valid. Exams will be offered two additional terms after the course was given at last.

Modules that have already been taken in the program of the Bachelor’s degree in Mechatronics and Information Technology or in related programs cannot be selected as supplementary

modules in the Master's degree program. If a compulsory module has already been taken in the Bachelor's degree program, it will be replaced by a supplementary module of the chosen Field of Specialization.

If there is demonstrably no place available in all the selectable internships of the desired Field of Specialization, then, as an exception, an internship of a different Field of Specialization, that is suitable in terms of content, can be selected. This requires the approval of a program consultant (<https://www.mach.kit.edu/1982.php?tab=%5B2693%5D#tabpanel-2693>).

Students who have already chosen a Field of Specialization that is no longer offered in the current curriculum, please refer to previous module handbooks in the archive (https://www.etit.kit.edu/modulhandbuecher_archiv.php).

Interdisciplinary Subject

The Interdisciplinary Subject consists of modules in the amount of 17 CR. If 17 CR cannot be achieved through the choice of modules exactly, overbooking by a maximum of one module is possible. The modules can be freely chosen by the students from the modules listed below. Other courses of the Master's degree programs in Electrical Engineering and Information Technology, Mechanical Engineering, or Informatics/Computer Science can be chosen after application at the Program Service Master. The chosen modules should fit thematically to the Field of Specialization and at most one practical course and one seminar should be chosen.

Particularly in the case of courses offered by the KIT Department of Informatics, the consent of the lecturer(s) must be obtained before a module is included in the Interdisciplinary Subject.

In the process, it must also be clarified whether the students have the necessary subject-specific prerequisites for the selected module. This matching is the responsibility of the student.

In the Interdisciplinary Subject, no module can be selected, which has already been selected in the Field of Specialization or which has already been examined in the Bachelor's degree program in Mechatronics and Information Technology or in related degree programs.

The choice of supplementary modules in the Field of Specialization and modules in the Interdisciplinary Subject is made electronically in Campus Management Portal (<https://campus.studium.kit.edu/english/index.php>).

Interdisciplinary Qualifications

Interdisciplinary Qualifications are modules with a predominantly non-technical content; these must be completed with an evaluated proof of credit points. The module "*Das Arbeitsfeld des Ingenieurs*" (2 CR) is already fixed. The other modules in the amount of 4 CR can be selected from the range of events offered by KIT.

For example, courses from the following areas are recommended: Management, Entrepreneurship, Business Administration, Law, Patents. Typically, these are courses from the HOC, ZAK, and Language Center (SPZ), as well as Interdisciplinary Qualifications offered by the KIT Department of Electrical Engineering and Information Technology and the KIT Department of Mechanical Engineering. Further Interdisciplinary Qualifications can be acquired within the subject "Additional Examinations".

Achievements can be booked in the module “Key Competences (*Schlüsselqualifikationen*)” by the students themselves. Students can access the module via the menu item “Examinations – Exam Registration and Unregistration” at the Campus Management Portal, which is also used to access the study schedule. Here you will find a tab “ÜQ/SQ-Leistungen”, which displays the list of unassigned own achievements.

In the following, the taken Interdisciplinary Qualifications have to be assigned to the courses (*Teilleistungen*) of HoC, ZAK or SPZ with the title “Self Assignment-HOC-SPZ-ZAK...” according to the grading scale, graded or ungraded. Title and credits of the achievement are adopted automatically.

1.3. Curriculum

Subject/Modul	1. Term				2. Term				3. Term			
	V	Ü	P	CR	V	Ü	P	CR	V	Ü	P	CR
Technische Mechanik	3			5								
Measurement Technology	2	1		5								
Field of Specialization				15								
Interdisciplinary Subject				5								
Numerical Methods					2	1		5				
Produktentstehung - Entwicklungsmethodik					3			6				
Werkstoffe					3			5				
Das Arbeitsfeld des Ingenieurs					2			2				
Field of Specialization								6				
Interdisciplinary Subject								6				
Regelung linearer Mehrgrößensysteme									3	1		6
Interdisciplinary Qualifications												4
Field of Specialization												14
Interdisciplinary Subject												6

4. Term: Master's Thesis (30 CR)

Exemplary curriculum in the Field of Specialization Industrieautomation

1. Term (WS)

PF: T-MACH-110375	Math. Methoden der Kontinuumsmechanik	5 CR writ.
PF: M-ETIT-102652	Measurement Technology	5 CR writ.
VF: M-ETIT-100531	Optimization of Dynamic Systems	5 CR writ.
VF: M-INFO-100893	Robotik I - Einführung in die Robotik	6 CR writ.
IF: M-ETIT-100399	Schaltungstechnik in der Industrieelektronik	3 CR oral
IF: M-ETIT-105915	Regelung leistungselektronischer Systeme	6 CR oral

Number of CR: 30

Number of oral examinations: 2

Number of written examinations: 4

2. Term (SS)

PF: M-MATH-105831	Numerical Methods	5 CR writ.
PF: T-MACH-109192	Methoden und Prozesse der PGE	6 CR writ.
PF: T-MACH-100531	Systematische Werkstoffauswahl	5 CR writ.
VF: M-MACH-104983	Plug-and-Play Fördertechnik	4 CR other type
VF: M-MACH-105281	Informationssysteme in Logistik und Supply Chain Management	3 CR oral
VF: M-MACH-105286	BUS-Steuerungen	4 CR oral
ÜQ: M-MACH-102755	Das Arbeitsfeld des Ingenieurs	2 CR writ.
Number of CR: 29		
Number of oral examinations: 2		
Number of written examinations: 4		
Number of examinations of other types: 1		

3. Term (WS)

PF: T-ETIT-100666	Regelung linearer Mehrgrößensysteme	6 CR writ.
VF: M-MACH-105296	Computational Intelligence	4 CR writ.
VF: M-MACH-104984	Materialfluss in Logistiksystemen	9 CR other type
IF: M-MACH-102692	Elektrische Schienenfahrzeuge	4 CR oral
IF: M-ETIT-100417	Hochspannungsprüftechnik	4 CR oral
ÜQ:	Überfachliche Qualifikationen	4 CR other type
Number of CR: 31 CR		
Number of oral examinations: 2		
Number of written examinations: 2		
Number of examinations of other types: 2		

4. Term (SS)

MT:	Master's Thesis	30 CR
Number of CR: 30		
Number of oral examinations: -		
Number of written examinations: -		

Total number of examinations: 19

1.4. Additional Examinations

According to SPO Article 15, additional examinations can be acquired, that may result in up to 30 credit points more than required for passing the Master's examination. When registering for an examination in a module, this must already be declared as an additional examination. The assignment of a module can be changed again later on request. Additional examinations are not included in the overall grade, but are listed in the Transcript of Records.

1.5. Recognition of external study achievements

The basic rules for the recognition of external achievements (credits and grades) can be found in the study and examination regulations:

- Bachelor SPO 2016 of 03-05-2016, Article 19 and changes of 28-09-2018, Article 19
- Master SPO 2015 of 10-07-2015, Article 18 and correction of 30-06-2016

According to these regulations, the achievements required in the curriculum can also be achieved through recognition of external credits and grades.

External achievements may be acquired as follows:

1. within the higher education system (worldwide)
2. outside the higher education system (at institutions with standardized quality assurance systems; recognition may be denied if more than 50 percent of the curriculum are to be substituted)

Recognition is granted upon application by the student. With regard to the acquired competencies, it must be ensured that there is no significant difference to the achievements or degrees that are to be replaced. The application must be submitted within the first semester after enrollment at KIT.

The examination board is responsible for recognition and crediting and involves the responsible program consultant in the decision. Recognized credits and grades that were not achieved at KIT are shown as “recognized” in the transcript of records.

There are two options for recognition:

- **Recognition instead of a KIT event**
An event taught at KIT is replaced by the recognized event. The examination whether the acquired competences are equivalent to the KIT event is carried out by the subject examiner who conducts the event to be replaced at KIT.
- **Recognition of the original event**
The event will be recognized with the original title. The course can be taken in the Interdisciplinary Subject, in the Interdisciplinary Qualifications, or in the Additional Examinations. The examination whether the acquired competences justify a recognition is carried out by the program consultant.

Experience has shown that recognition “instead of” is difficult, because the competencies taught in courses are usually determined by the lecturer and are rarely the same at other universities. Recognition of “the original”, on the other hand, only checks whether the competencies acquired are appropriate to a university course.

If a comparable grading system is used, the grade of the performance to be recognized is taken over. If the grading system is not comparable, the grade will be converted. Examination which are to be recognized instead of a graded examination must also be graded.

The exact procedure is described at “Richtlinien zur Anerkennung von Studien- und Prüfungsleistungen im Studiengang Mechatronik und Informationstechnik” (in German: <https://www.mach.kit.edu/Master-MIT.php?tab=%5B3682%5D#tabpanel-3682>).

1.6. Semester abroad and student mobility

The KIT departments support and promote stays abroad. For this purpose, there are a number of partnerships with foreign universities. Please contact the departments for up-to-date information. However, students are also encouraged to contact foreign universities on their own.

It is advisable to complete most of the compulsory modules in General Mechatronics and in the Field of Specialization before the stay abroad. The work done at the foreign institution can then be recognized in the Interdisciplinary Subject and in the Interdisciplinary Qualifications. Therefore, the third semester is well suited for a stay abroad.

Prior to the stay abroad, the achievements to be made at the foreign university are fixed in a written Learning Agreement. The current form and detailed information can be found on the websites of the KIT Department of Electrical Engineering and Information Technology

(https://www.etit.kit.edu/erasmus_outgoing.php) and the KIT Department of Mechanical Engineering (<https://www.mach.kit.edu/1703.php>). Under the title "Recognition at the Sending Institution" it is stated in which subject the modules in the degree program Mechatronics and Information Technology are recognized at KIT. Please contact a program consultant with the completed form.

After the stay abroad, the examination results obtained abroad will be recognized in accordance with the procedure in section 1.5.

1.7. Calculation of grades

The module grades in General Mechatronics, the Field of Specialization, and the Interdisciplinary Subject are weighted with the corresponding credit points to form the overall grade. The calculation of grades is based on the regulations of the study and examination regulations, Article 7, paragraph 4, 7, and 9 as well as Article 2, paragraph 2.

1.8. Master's Thesis

The Master's Thesis should demonstrate that the student is able to work on a problem from the field of mechatronics and information technology independently and within a limited time, using scientific methods that correspond to the state of the art in research. The module Master's Thesis is assigned to 30 credit points. It consists of the Master's Thesis and a final presentation of the results. The presentation has to take place within the preparation of the Master's Thesis.

The prerequisite for admission to the module Master's Thesis is that the student is usually in the 2nd year of study and has successfully completed module examinations in the sum of 75 CR.

The recommended preparation time is four months in full-time. The maximum preparation time is six months.

The Master's Thesis may be completed at all institutes at the KIT Department of Electrical Engineering and Information Technology and the KIT Department of Mechanical Engineering.

Due to the interdisciplinary orientation, the participation of institutes of other faculties is desired. With the approval of the examination board, external Master's Theses can also be approved, provided that supervision by a university lecturer is guaranteed. The registration of the Master's Thesis has to be done electronically in the Campus Management by the students themselves (<https://campus.studium.kit.edu/english/index.php>), but only after consultation and approval by the supervising professor.

2. Goals, structure and acquisition of competences

2.1 Competence Goals

The competence goals of the Master's degree program Mechatronics and Information Technology are divided into the following four main competence profiles:

1. **Expertise:** Students get to know the fundamentals of the discipline, as well as current research topics, processes, and results.
2. **Research and problem-solving skills:** Students learn the skills and techniques to meet challenges in research and industry.
3. **Assessment and planning skills:** Students participate in professional and research discourse and apply acquired knowledge, as well as learned techniques.
4. **Personal and social skills:** Students work on (their own) research projects, are integrated into a scientific team, are capable of independent and sustained professional and scientific development, and assess the social and societal impact of their activities.

For points 1 and 2 the focus is on lecturer activity, for points 3 and 4 correspondingly on student activity.

For the Master's degree program, these competence requirements can be further described in the following objectives:

A – Expert knowledge: The graduates of the Master's degree program Mechatronics and Information Technology

1. have an in-depth knowledge of mathematics and physics and an advanced expert knowledge of electrical and mechanical engineering as well as information technology. They are able to recognize and evaluate demanding technical and scientific tasks and problems in mechatronics and information technology and to formulate approaches to solve them.
2. master demanding scientific methods of their discipline and have learned to use them to analyze identified problems or subject-related issues according to the state of their knowledge.
3. possess in-depth knowledge in a combination of the core competences of mechatronics and information technology (e.g. automation and control technology, electrical energy systems, high-voltage technology, electrical drives, power electronics, digital technology, information technology, digital signal processing, communications engineering, high-frequency technology, measurement technology, imaging techniques, lighting technology, optoelectronics, circuitry, microelectronics, optical communication systems, materials science, construction and product development, engineering mechanics, robotics, modern software techniques).

B – Research and problem-solving skills: The graduates of the Master's degree program Mechatronics and Information Technology

1. are qualified to work as engineers and scientists in one of the main application fields of mechatronics and information technology (e.g. Automotive Engineering, Power Engineering, Automation Technology, Industrial Handling, Microsystems Technology, Medical Technology).
2. are familiar with the procedures for the analysis and design of components, circuits, systems, and equipment in mechatronics.
3. are familiar with advanced methods of presenting and processing information, programming, algorithmic formulation of processes, and the use of programming tools.
4. possess an in-depth understanding of the methods of mechatronics and information technology.
5. are capable of further qualification through a doctorate program (PhD).

C – Assessment and planning skills: The graduates of the Master's degree program Mechatronics and Information Technology

1. can evaluate mechatronic designs based on elements of electrical and mechanical engineering as well as information technology, using various solution alternatives.
2. recognize limits of the validity of theories and solutions in a wide variety of applications and new developments.
3. can critically question results and transfer solutions to other areas of application.

D – Personal and social skills: The graduates of the Master's degree program Mechatronics and Information Technology

1. are familiar with independent project work as well as interdisciplinary teamwork, are able to grasp the results of others, and are able to communicate their own and team results in writing and orally.
2. are able to familiarize themselves independently with new and complex subject areas in technical sciences and their methods.
3. are able to work scientifically on research-related problems and develop complex assemblies or systems.
4. possess a deeper understanding of applications of mechatronics and information technology in various fields of work, know the limits and dangers involved, and apply their knowledge responsibly and for the benefit of society, taking safety and ecological requirements into account. They actively contribute to the opinion-forming process in society with regard to scientific and technical issues.
5. are able to communicate and cooperate with specialists in an interdisciplinary manner.

2.2 Conformity of module structure with competence goals

The Master's degree program is structured according to the following concept:

- Teaching of basic engineering knowledge within the compulsory subject of General Mechatronics in the first two terms to the extent of 32 credit points. Included are basic modules that convey the basic scientific knowledge of mechatronics, e.g. numerical mathematical methods, multibody dynamics, product development, methods of product engineering, materials selection, measurement technology, control engineering.
- Intensive specialization in an area of choice. For this purpose, eight Fields of Specialization with a total of 35 credit points are offered. Each Field of Specialization consists mainly of compulsory modules (core modules), which are specified according to the chosen Field of Specialization. In addition, further courses (supplementary modules) of the areas electrical and mechanical engineering as well as information and computer technology are offered, which the students can compile themselves.
- Further specialization is possible within the framework of the Interdisciplinary Subject (17 credit points). The modules of the Interdisciplinary Subject are compiled by the students from the master's courses of the areas electrical and mechanical engineering as well as information and computer technology.
- The range of specific elective modules – some are held by lecturers from renowned research institutions and industry – is very large. To provide a flexible offer, some modules are designated with less than 5 credit points. This is explicitly supported by the student representatives.
- The final module composition should be coherent in content and must be approved by the program consultant.

- During the preparation of their Master's thesis, students are guided to conduct independent scientific research.

The final choice of the individual Field of Specialization may be accomplished in the second or third term, as illustrated in the following table:

Term	Subject	LP/CR
1	General Mechatronics (32 CR) Field of Specialization (35 CR) Interdisciplinary Subject (17 CR)	30
2		30
3		24
	Interdisciplinary Qualifications	6
4	Master's Thesis	30

An essential fundamental component of the Master's degree program is the great freedom that students are given in the selection of elective modules, the Interdisciplinary Qualifications, and the entire scheduling of studies. This way the students' self and social competence can be optimally promoted.

The structure of the Master's degree program and its modules thus support the qualification goals, formulated above:

The fundamentally oriented courses of the compulsory subject Mechatronics are primarily completed in the first two terms. Based on this is the Field of Specialization, in which students can choose from one of eight specializations. The courses in the Field of Specialization are mainly held in the second and third term. At the same time, starting in the first term, the Interdisciplinary Qualifications are completed.

Finally, the fourth term is reserved for the Master's Thesis.

2.3 Acquisition of competences

In the Master's degree program, the acquisition of interdisciplinary competencies is promoted through seminars, university internships, Interdisciplinary Qualifications, and the Master's Thesis, as well as through the general organization of the studies.

Most students complete a seminar as part of the Interdisciplinary Subject (seminars are offered by many institutes and are basically structured in the same way). There they specifically learn to conduct independent literature research, have to apply oral and technical presentation skills and prepare documentations. They learn to work in a self-organized and reflexive manner and improve their communicative, organizational, and didactical skills. They have to analyze a topic independently and present it to an expert audience.

In the university's internships and laboratories (each Field of Specialization contains an internship as a core module), the focus is on imparting expert knowledge and the practical handling of laboratory equipment or software tools. Here, students will sharpen their analytical skills through playful handling of technology and, at the same time, learn how to work together in teams and develop their own ideas and solutions.

The Interdisciplinary Qualifications with an amount of 6 CR are scheduled within the first to third term.

In the first term, a specific ring course is offered in the Master's degree program in Mechatronics and Information Technology. Within this course professors impart their professional

experience and practical knowledge in the areas of project management, cooperation with production and marketing, governance, processes, and organization.

In the third term, another specific course is offered in the Master's degree program, in which students are taught theoretical knowledge as well as practical experience in leading interdisciplinary teams (under guidance). This is done in cooperation with the workshop "Mechatronische Systeme und Produkte" of the Bachelor's degree program in Mechatronics and Information Technology.

In addition, courses from the KIT-Department of Electrical Engineering and Information Technology, Mechanical Engineering, and other departments or the House of Competence can be chosen. The selected courses must have a predominantly non-technical content and should be related to the future professional field of an engineer. The Interdisciplinary Qualifications are intended to build up competencies in interdisciplinary thinking, in conveying expert knowledge from non-electrical or non-mechanical engineering disciplines, as well as in writing and speaking a foreign language.

The Master's Thesis, which must be completed in the fourth term, corresponds to 30 CR. Students learn how to apply scientific methods in the development of new ideas and solutions. They train their analytical thinking as well as working efficiently towards a goal under a given timeline. In addition, students learn to organize themselves and their work process effectively. Knowledge gaps are identified and closed. The Master's Thesis ends with a final presentation of about 20 minutes followed by a discussion (defense). During the preparation of the presentation, the students are guided and supported by their supervisors. The students learn to communicate own and collaboratively developed results in written and oral form. While working on the Master's Thesis, it is expected to attend the presentations and defenses of fellow students. This trains to communicate and collaborate with specialists in related disciplines.

The ability to work independently, to organize oneself optimally, and to clearly structure even large long-term tasks can hardly be conveyed in a course by simple explanation. In order to enable students to train themselves optimally in this respect, a large degree of freedom in the selection of courses, in the Interdisciplinary Subject, the Interdisciplinary Qualifications, and the entire scheduling of studies is an essential part of the Master's degree program. Only in this way students can optimally attain self- and social competence.

3 Field of study structure

Mandatory	
Master's Thesis	30 CR
General Mechatronics	32 CR
Field of Specialization	35 CR
Interdisciplinary Subject	17 CR
Interdisciplinary Qualifications	6 CR
Voluntary	
Additional Examinations	
<i>This field will not influence the calculated grade of its parent.</i>	

3.1 Master's Thesis

Credits
30

Mandatory		
M-ETIT-103253	Master's Thesis	30 CR

3.2 General Mechatronics

Credits
32

Mandatory		
M-ETIT-100374	Control of Linear Multivariable Systems	6 CR
M-ETIT-102734	Materials	5 CR
M-MACH-102718	Product Development – Methods of Product Engineering	6 CR
M-MATH-105831	Numerical Methods	5 CR
M-ETIT-105982	Measurement Technology	5 CR
M-MACH-103205	Engineering Mechanics	5 CR

3.3 Field of Specialization

Credits
35

Field of Specialization (Election: 1 item)	
Field of Specialization: Automotive Engineering	35 CR
Field of Specialization: Power Engineering	35 CR
Field of Specialization: Microsystems Technology	35 CR
Field of Specialization: Medical Technology	35 CR
Field of Specialization: Industrial Automation	35 CR
Field of Specialization: Control Engineering in Mechatronics	35 CR
Field of Specialization: Robotics	35 CR
Field of Specialization: Design of Mechatronic Systems	35 CR

3.3.1 Field of Specialization: Automotive Engineering

Credits
35

Part of: Field of Specialization

Election notes

In the Field of Specialization "Automotive Engineering" 35 CR must be selected. Through the compulsory modules and according to the chosen Internship, there is a remaining number of 5-10 CR for the Complementary Modules.

Please make sure that this number is exactly met or exceeded once. Excess modules will be moved to the Interdisciplinary Subject.

Starting winter term 21/22, "M-ETIT-100514 - Hybride und elektrische Fahrzeuge" will be replaced by "M-ETIT-100532 - Batterien und Brennstoffzellen". The latter is thus omitted in the Complementary Modules.

Students who have already successfully completed "Hybride und elektrische Fahrzeuge", please contact the Program Service Master (master-info@etit.kit.edu) for booking "Batterien und Brennstoffzellen" in the Complementary Modules.

Mandatory		
M-ETIT-100532	Batteries and Fuel Cells	5 CR
M-MACH-100501	Automotive Engineering I	8 CR
M-MACH-100502	Automotive Engineering II	4 CR
M-MACH-102683	Rail Vehicle Technology	4 CR
Internships (Election: 1 item)		
M-MACH-102695	Motor Vehicle Laboratory	4 CR
M-ETIT-100381	Batteries and Fuel Cells Laboratory	6 CR
M-ETIT-100401	Lab Course Electrical Drives and Power Electronics	6 CR
M-MACH-105725	Seamless Engineering	9 CR
M-MACH-106050	Reliability and Test Engineering	5 CR
Complementary Modules (Election:)		
M-MACH-105800	Drive Train of Mobile Machines	4 CR
M-MACH-103232	Rail System Technology	4 CR
M-ETIT-100377	Battery and Fuel Cells Systems	3 CR
M-MACH-102700	Dynamics of the Automotive Drive Train	5 CR
M-ETIT-100515	Design of Electrical Machines	5 CR
M-MACH-105288	Handling Characteristics of Motor Vehicles I	4 CR
M-MACH-102703	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR
M-MACH-102693	Automotive Vision	6 CR
M-MACH-105824	Fundamentals in the Development of Commercial Vehicles	4 CR
M-MACH-105289	Principles of Whole Vehicle Engineering I	2 CR
M-MACH-105290	Principles of Whole Vehicle Engineering II	2 CR
M-INFO-105623	Reinforcement Learning	5 CR

3.3.2 Field of Specialization: Power Engineering**Credits****Part of: Field of Specialization****35****Election notes**

In the Field of Specialization "Power Engineering" 35 CR must be selected. Through the compulsory modules and according to the chosen Internship, there is a remaining number of 7-10 CR for the Complementary Modules.

Please make sure that this number is exactly met or exceeded once. Excess modules will be moved to the Interdisciplinary Subject.

Mandatory		
M-ETIT-100572	Power Network	6 CR
M-MACH-102690	Fundamentals of Energy Technology	8 CR
M-ETIT-104567	Power Electronics	6 CR
Internships (Election: 1 item)		
M-ETIT-100419	Lab Course Electrical Power Engineering	6 CR
M-ETIT-100401	Lab Course Electrical Drives and Power Electronics	6 CR
M-ETIT-100415	Laboratory Information Systems in Power Engineering	6 CR
M-INFO-105955	Practical Course: Smart Energy System Lab	6 CR
M-ETIT-102350	Laboratory Solar Energy	6 CR
M-MACH-105725	Seamless Engineering	9 CR
Complementary Modules (Election:)		
M-ETIT-100532	Batteries and Fuel Cells	5 CR
M-WIWI-100498	Introduction into Energy Economics	5 CR
M-INFO-101885	Energy Informatics 1	5 CR
M-INFO-103044	Energy Informatics 2	5 CR
M-ETIT-100534	Power Transmission and Power Network Control	5 CR
M-ETIT-100413	Power Systems and Economy	3 CR
M-ETIT-100515	Design of Electrical Machines	5 CR
M-MACH-102707	Fundamentals of Combustion I	4 CR
M-ETIT-106067	Power Electronic Systems in Energy Technology	6 CR
M-MACH-102714	Microenergy Technologies	4 CR
M-ETIT-100513	Photovoltaics	6 CR
M-ETIT-100394	Practical Aspects of Electrical Drives	4 CR
M-INFO-103153	Seminar: Energy Informatics	4 CR
M-ETIT-103447	Seminar Novel Concepts for Solar Energy Harvesting	3 CR
M-ETIT-100524	Solar Energy	6 CR
M-MACH-102388	Thermal Solar Energy	4 CR
M-MACH-102717	Heat and Mass Transfer	4 CR

3.3.3 Field of Specialization: Microsystems Technology**Credits****Part of: Field of Specialization****35****Election notes**

In the Field of Specialization "Microsystems Technology" 35 CR must be selected. Through the compulsory modules and according to the chosen Internship, there is a remaining number of 7-12 CR for the Complementary Modules.

Please make sure that this number is exactly met or exceeded once. Excess modules will be moved to the Interdisciplinary Subject.

Mandatory		
M-MACH-100489	BioMEMS - Microsystems Technologies for Life Sciences and Medicine I	4 CR
M-MACH-102691	Introduction to Microsystem Technology I	4 CR
M-MACH-102706	Introduction to Microsystem Technology II	4 CR
M-MACH-100487	Microactuators	4 CR
M-ETIT-100378	Sensors	3 CR
Internships (Election: 1 item)		
M-ETIT-100451	System-on-Chip Laboratory	6 CR
M-MACH-105479	Practical Training in Basics of Microsystem Technology	4 CR
M-MACH-105725	Seamless Engineering	9 CR
Complementary Modules (Election:)		
M-MACH-102698	Actuators and Sensors in Nanotechnology	4 CR
M-MACH-105485	Current Topics on BioMEMS	4 CR
M-MACH-100490	BioMEMS - Microsystems Technologies for Life Sciences and Medicine II	4 CR
M-MACH-100491	BioMEMS - Microsystems Technologies for Life Sciences and Medicine III	4 CR
M-MACH-105483	BioMEMS - Microsystemtechnology for Life-Science and Medicine IV	4 CR
M-MACH-105484	BioMEMS - Microfluidic Chipsystems V	4 CR
M-MACH-105478	Fabrication Processes in Microsystem Technology	4 CR
M-INFO-100895	Information Processing in Sensor Networks	6 CR
M-ETIT-100474	Integrated Systems and Circuits	4 CR
M-MACH-102713	Mechanics in Microtechnology	4 CR
M-MACH-102714	Microenergy Technologies	4 CR
M-MACH-105486	Micro System Simulation	4 CR
M-ETIT-100454	Microsystem Technology	3 CR
M-ETIT-100455	Seminar Embedded Systems	3 CR
M-ETIT-105607	Seminar on Quantum Detectors and Sensors	3 CR
M-MACH-105315	System Integration in Micro- and Nanotechnology	4 CR
M-MACH-105316	System Integration in Micro- and Nanotechnology 2	4 CR

3.3.4 Field of Specialization: Medical Technology**Credits****Part of: Field of Specialization****35****Election notes**

In the Field of Specialization "Medical Technology" 35 CR must be selected. Through the compulsory modules there is a remaining number of 11 CR for the Complementary Modules.

Please make sure that this number is exactly met or exceeded once. Excess modules will be moved to the Interdisciplinary Subject.

Mandatory		
M-ETIT-100384	Medical Imaging Techniques I	3 CR
M-ETIT-100387	Biomedical Measurement Techniques I	3 CR
M-MACH-100489	BioMEMS - Microsystems Technologies for Life Sciences and Medicine I	4 CR
M-MACH-102702	Organ Support Systems	4 CR
M-MACH-102720	Principles of Medicine for Engineers	4 CR
M-ETIT-100389	Laboratory Biomedical Engineering	6 CR
Complementary Modules (Election:)		
M-INFO-103294	Wearable Robotic Technologies	4 CR
M-MACH-105485	Current Topics on BioMEMS	4 CR
M-ETIT-100385	Medical Imaging Techniques II	3 CR
M-ETIT-100549	Bioelectric Signals	3 CR
M-ETIT-100388	Biomedical Measurement Techniques II	3 CR
M-MACH-100490	BioMEMS - Microsystems Technologies for Life Sciences and Medicine II	4 CR
M-MACH-100491	BioMEMS - Microsystems Technologies for Life Sciences and Medicine III	4 CR
M-MACH-105483	BioMEMS - Microsystemtechnology for Life-Science and Medicine IV	4 CR
M-MACH-105484	BioMEMS - Microfluidic Chipsystems V	4 CR
M-INFO-100725	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy neu	3 CR
M-ETIT-105874	Physiology and Anatomy for Biomedical Engineering	6 CR
M-INFO-102374	Seminar Accessibility - Assistive Technologies for Visually Impaired Persons	3 CR
M-ETIT-100560	Ultrasound Imaging neu	3 CR

3.3.5 Field of Specialization: Industrial Automation**Credits****Part of: Field of Specialization****35****Election notes**

In the Field of Specialization "Industrial Automation" 35 CR must be selected. Through the compulsory modules and according to the chosen Internship, there is a remaining number of 8-13 CR for the Complementary Modules.

Please make sure that this number is exactly met or exceeded once. Excess modules will be moved to the Interdisciplinary Subject.

Mandatory		
M-MACH-105296	Computational Intelligence	4 CR
M-MACH-104984	Material Flow in Logistic Systems	9 CR
M-ETIT-100531	Optimization of Dynamic Systems	5 CR
Internships (Election: 1 item)		
M-MACH-102687	Decentrally Controlled Intralogistic Systems	4 CR
M-MACH-102699	Laboratory Mechatronics	4 CR
M-MACH-104983	Plug-and-Play Material Handling	4 CR
M-ETIT-103448	Laboratory Mechatronic Measurement Systems	6 CR
M-MACH-105725	Seamless Engineering	9 CR
M-MACH-106050	Reliability and Test Engineering	5 CR
Complementary Modules (Election:)		
M-MACH-105108	Automated Manufacturing Systems	8 CR
M-MACH-105286	BUS-Controls	4 CR
M-ETIT-106039	Cyber Physical Production Systems	4 CR
M-MACH-105476	Digitalization of Products, Services & Production	4 CR
M-MACH-102688	Elements of Technical Logistics	4 CR
M-MACH-105015	Elements of Technical Logistics incl. Project	6 CR
M-ETIT-103043	Manufacturing Measurement Technology	3 CR
M-MACH-105283	Basics of Technical Logistics I	4 CR
M-MACH-105281	Information Systems and Supply Chain Management	3 CR
M-ETIT-100367	Information Technology in Industrial Automation Systems	3 CR
M-MACH-105282	IT-Fundamentals of Logistics: Opportunities for Digital Transformation	4 CR
M-MACH-105968	Artificial Intelligence in Production	8 CR
M-MACH-105298	Logistics and Supply Chain Management	9 CR
M-INFO-100893	Robotics I - Introduction to Robotics	6 CR
M-MACH-105477	Seminar Data-Mining in Production	3 CR
M-MACH-105107	Machine Tools and Industrial Handling	8 CR

3.3.6 Field of Specialization: Control Engineering in Mechatronics**Credits****Part of: Field of Specialization****35****Election notes**

In the Field of Specialization "Control Engineering in Mechatronics" 35 CR must be selected. Through the compulsory modules and according to the chosen Internship, there is a remaining number of 11-16 CR for the Complementary Modules.

Please make sure that this number is exactly met or exceeded once. Excess modules will be moved to the Interdisciplinary Subject.

Mandatory		
M-INFO-106299	Advanced Artificial Intelligence neu	6 CR
M-ETIT-100531	Optimization of Dynamic Systems	5 CR
M-ETIT-100361	Distributed Discrete Event Systems	4 CR
Internships (Election: 1 item)		
M-ETIT-105467	Control Theory Laboratory	6 CR
M-MACH-105291	Lab Computer-Aided Methods for Measurement and Control	4 CR
M-MACH-105725	Seamless Engineering	9 CR
M-MACH-106050	Reliability and Test Engineering	5 CR
Complementary Modules (Election:)		
M-INFO-104460	Deep Learning and Neural Networks	6 CR
M-MACH-105612	Dynamics of Electro-Mechanical Systems	5 CR
M-INFO-100803	Real-Time Systems	6 CR
M-INFO-105778	Machine Learning - Foundations and Algorithms	5 CR
M-WIWI-105003	Machine Learning 1	5 CR
M-WIWI-105006	Machine Learning 2	5 CR
M-MACH-102694	Machine Dynamics	5 CR
M-MACH-105308	Modern Control Concepts I	4 CR
M-MACH-105313	Modern Control Concepts II	4 CR
M-MACH-105314	Modern Control Concepts III	4 CR
M-ETIT-100371	Nonlinear Control Systems	3 CR
M-ETIT-102310	Optimal Control and Estimation	3 CR
M-ETIT-105468	Physical and Data-Based Modelling	6 CR
M-ETIT-105915	Control of Power-Electronic Systems	6 CR
M-INFO-105623	Reinforcement Learning	5 CR
M-INFO-100829	Stochastic Information Processing	6 CR

3.3.7 Field of Specialization: Robotics**Credits****Part of: Field of Specialization****35****Election notes**

In the Field of Specialization "Robotics" 35 CR must be selected. Through the compulsory modules and according to the chosen Internship, there is a remaining number of 9-14 CR for the Complementary Modules.

Please make sure that this number is exactly met or exceeded once. Excess modules will be moved to the Interdisciplinary Subject.

Mandatory		
M-ETIT-100531	Optimization of Dynamic Systems	5 CR
M-INFO-100893	Robotics I - Introduction to Robotics	6 CR
M-INFO-102756	Robotics II - Humanoid Robotics	3 CR
M-INFO-104897	Robotics III - Sensors and Perception in Robotics	3 CR
Internships (Election: 1 item)		
M-MACH-104983	Plug-and-Play Material Handling	4 CR
M-ETIT-100364	Laboratory Digital Signal Processing	6 CR
M-MACH-105291	Lab Computer-Aided Methods for Measurement and Control	4 CR
M-INFO-102224	Practical Project Robotics and Automation I (Software)	6 CR
M-INFO-102230	Practical Project Robotics and Automation II (Hardware)	6 CR
M-INFO-102522	Robotics - Practical Course	6 CR
M-INFO-105792	Humanoid Robotics Laboratory	6 CR
M-MACH-105725	Seamless Engineering	9 CR
M-MACH-106050	Reliability and Test Engineering	5 CR
Complementary Modules (Election:)		
M-INFO-103294	Wearable Robotic Technologies	4 CR
M-INFO-100826	Automated Visual Inspection and Image Processing	6 CR
M-INFO-100814	Biologically Inspired Robots	3 CR
M-MACH-105296	Computational Intelligence	4 CR
M-ETIT-100453	Hardware/Software Co-Design	4 CR
M-INFO-102561	Humanoid Robots - Seminar	3 CR
M-INFO-100791	Innovative Concepts for Programming Industrial Robots	4 CR
M-INFO-100840	Localization of Mobile Agents	6 CR
M-MACH-101923	Machine Vision	8 CR
M-INFO-100824	Human-Machine-Interaction in Anthropomatics: Basics	3 CR
M-MACH-100487	Microactuators	4 CR
M-INFO-102555	Motion in Human and Machine - Seminar	3 CR
M-ETIT-100371	Nonlinear Control Systems	3 CR
M-INFO-102212	Seminar Intelligent Industrial Robots	3 CR
M-MACH-105348	Control Technology	4 CR

3.3.8 Field of Specialization: Design of Mechatronic Systems**Credits****Part of: Field of Specialization****35****Election notes**

In the Field of Specialization "Design of Mechatronic Systems" 35 CR must be selected. Through the compulsory modules and according to the chosen Internship, there is a remaining number of 6-11 CR for the Complementary Modules.

Please make sure that this number is exactly met or exceeded once. Excess modules will be moved to the Interdisciplinary Subject.

Mandatory		
M-MACH-105292	Novel Actuators and Sensors	4 CR
M-ETIT-100394	Practical Aspects of Electrical Drives	4 CR
M-ETIT-104475	Project Management in the Development of Products for Safety-Critical Applications	4 CR
M-MACH-105107	Machine Tools and Industrial Handling	8 CR
Internships (Election: 1 item)		
M-MACH-102684	CAE-Workshop	4 CR
M-MACH-102705	Appliance and Power Tool Design	8 CR
M-MACH-102699	Laboratory Mechatronics	4 CR
M-MACH-102711	Production Techniques Laboratory	4 CR
M-MACH-105725	Seamless Engineering	9 CR
M-MACH-105475	Virtual Engineering Lab	4 CR
M-MACH-106050	Reliability and Test Engineering	5 CR
Complementary Modules (Election:)		
M-MACH-105286	BUS-Controls	4 CR
M-ETIT-106039	Cyber Physical Production Systems	4 CR
M-MACH-105612	Dynamics of Electro-Mechanical Systems	5 CR
M-INFO-100753	Design Principles for Interactive Real-Time Systems	3 CR
M-ETIT-103264	Information Fusion	4 CR
M-MACH-102696	Lightweight Engineering Design	4 CR
M-MACH-105968	Artificial Intelligence in Production	8 CR
M-MACH-102694	Machine Dynamics	5 CR
M-MACH-105332	Quality Management	4 CR
M-ETIT-105915	Control of Power-Electronic Systems	6 CR
M-MACH-105318	Technical Design in Product Development	4 CR
M-INFO-100789	Ubiquitous Computing neu	5 CR
M-MACH-101283	Virtual Engineering A	9 CR

3.4 Interdisciplinary Subject

Credits

17

Election notes

The modules can be freely chosen by the students from the modules listed below. Other courses of the Master's degree programs in Electrical Engineering and Information Technology, Mechanical Engineering, or Informatics/Computer Science can be chosen after application at the Program Service Master. The chosen modules should fit thematically to the Field of Specialization and at most one practical course and one seminar should be chosen.

Particularly in the case of courses offered by the KIT Department of Informatics, the consent of the lecturer(s) must be obtained before a module is included in the Interdisciplinary Subject. In the process, it must also be clarified whether the students have the necessary subjectspecific prerequisites for the selected module. This matching is the responsibility of the student.

Interdisciplinary Subject (Election: at least 1 item as well as between 17 and 47 credits)		
M-MACH-102698	Actuators and Sensors in Nanotechnology	4 CR
M-MACH-105485	Current Topics on BioMEMS	4 CR
M-ETIT-100444	Applied Information Theory	6 CR
M-ETIT-100565	Antennas and Multiple Antenna Systems	5 CR
M-MACH-105800	Drive Train of Mobile Machines	4 CR
M-INFO-103294	Wearable Robotic Technologies	4 CR
M-INFO-100826	Automated Visual Inspection and Image Processing	6 CR
M-MACH-105108	Automated Manufacturing Systems	8 CR
M-MACH-103232	Rail System Technology	4 CR
M-ETIT-100377	Battery and Fuel Cells Systems	3 CR
M-ETIT-100532	Batteries and Fuel Cells	5 CR
M-ETIT-100384	Medical Imaging Techniques I	3 CR
M-ETIT-100385	Medical Imaging Techniques II	3 CR
M-ETIT-100549	Bioelectric Signals	3 CR
M-INFO-100814	Biologically Inspired Robots	3 CR
M-ETIT-100387	Biomedical Measurement Techniques I	3 CR
M-ETIT-100388	Biomedical Measurement Techniques II	3 CR
M-MACH-100489	BioMEMS - Microsystems Technologies for Life Sciences and Medicine I	4 CR
M-MACH-100490	BioMEMS - Microsystems Technologies for Life Sciences and Medicine II	4 CR
M-MACH-100491	BioMEMS - Microsystems Technologies for Life Sciences and Medicine III	4 CR
M-MACH-105483	BioMEMS - Microsystemtechnology for Life-Science and Medicine IV	4 CR
M-MACH-105484	BioMEMS - Microfluidic Chipsystems V	4 CR
M-MACH-105286	BUS-Controls	4 CR
M-MACH-102684	CAE-Workshop	4 CR
M-ETIT-105616	Channel Coding: Algebraic Methods for Communications and Storage	3 CR
M-MACH-105296	Computational Intelligence	4 CR
M-ETIT-100539	Communication Systems and Protocols	5 CR
M-ETIT-106039	Cyber Physical Production Systems	4 CR
M-INFO-105753	Deep Learning for Computer Vision I: Basics	3 CR
M-INFO-105755	Deep Learning for Computer Vision II: Advanced Topics	3 CR
M-INFO-104460	Deep Learning and Neural Networks	6 CR
M-ETIT-100466	Analog Circuit Design	4 CR
M-ETIT-100473	Digital Circuit Design	4 CR
M-MACH-102687	Decentrally Controlled Intralogistic Systems	4 CR
M-ETIT-102266	Digital Hardware Design Laboratory	6 CR
M-ETIT-106040	Digital Twin Engineering	4 CR
M-ETIT-105415	Digital Beam-Forming for Imaging Radar	4 CR
M-MACH-105476	Digitalization of Products, Services & Production	4 CR
M-MACH-102700	Dynamics of the Automotive Drive Train	5 CR
M-MACH-105612	Dynamics of Electro-Mechanical Systems	5 CR
M-ETIT-105916	Real Time Control of Electrical Drives	6 CR
M-INFO-100803	Real-Time Systems	6 CR
M-WIWI-100498	Introduction into Energy Economics	5 CR
M-ETIT-100572	Power Network	6 CR
M-MACH-105015	Elements of Technical Logistics incl. Project	6 CR
M-MACH-102688	Elements of Technical Logistics	4 CR
M-ETIT-100419	Lab Course Electrical Power Engineering	6 CR
M-ETIT-100534	Power Transmission and Power Network Control	5 CR
M-ETIT-100413	Power Systems and Economy	3 CR

M-WIWI-100499	Energy Systems Analysis	3 CR
M-ETIT-100515	Design of Electrical Machines	5 CR
M-MACH-102702	Organ Support Systems	4 CR
M-MACH-105288	Handling Characteristics of Motor Vehicles I	4 CR
M-MACH-102703	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR
M-MACH-102693	Automotive Vision	6 CR
M-ETIT-103043	Manufacturing Measurement Technology	3 CR
M-MACH-105478	Fabrication Processes in Microsystem Technology	4 CR
M-ETIT-100566	Field Propagation and Coherence	4 CR
M-INFO-106299	Advanced Artificial Intelligence neu	6 CR
M-MACH-102705	Appliance and Power Tool Design	8 CR
M-INFO-100753	Design Principles for Interactive Real-Time Systems	3 CR
M-MACH-102690	Fundamentals of Energy Technology	8 CR
M-MACH-100501	Automotive Engineering I	8 CR
M-MACH-100502	Automotive Engineering II	4 CR
M-MACH-102720	Principles of Medicine for Engineers	4 CR
M-MACH-102691	Introduction to Microsystem Technology I	4 CR
M-MACH-102706	Introduction to Microsystem Technology II	4 CR
M-MACH-105283	Basics of Technical Logistics I	4 CR
M-MACH-105302	Basics of Technical Logistics II	6 CR
M-MACH-102707	Fundamentals of Combustion I	4 CR
M-MACH-105824	Fundamentals in the Development of Commercial Vehicles	4 CR
M-MACH-105289	Principles of Whole Vehicle Engineering I	2 CR
M-MACH-105290	Principles of Whole Vehicle Engineering II	2 CR
M-ETIT-100449	Hardware Modeling and Simulation	4 CR
M-ETIT-100453	Hardware/Software Co-Design	4 CR
M-ETIT-100452	Hardware Synthesis and Optimisation	6 CR
M-ETIT-100417	High-Voltage Test Technique	4 CR
M-ETIT-105060	High-Voltage Technology	6 CR
M-ETIT-103264	Information Fusion	4 CR
M-MACH-105281	Information Systems and Supply Chain Management	3 CR
M-ETIT-100367	Information Technology in Industrial Automation Systems	3 CR
M-INFO-100895	Information Processing in Sensor Networks	6 CR
M-INFO-100791	Innovative Concepts for Programming Industrial Robots	4 CR
M-ETIT-100457	Integrated Intelligent Sensors	3 CR
M-ETIT-100474	Integrated Systems and Circuits	4 CR
M-MACH-105109	International Production Engineering	8 CR
M-MACH-105282	IT-Fundamentals of Logistics: Opportunities for Digital Transformation	4 CR
M-MACH-102712	Design with Plastics	4 CR
M-MACH-102696	Lightweight Engineering Design	4 CR
M-MACH-105180	Continuum Mechanics	5 CR
M-MACH-102695	Motor Vehicle Laboratory	4 CR
M-MACH-105968	Artificial Intelligence in Production	8 CR
M-ETIT-105467	Control Theory Laboratory	6 CR
M-ETIT-102261	Power Electronics for Photovoltaics and Wind Energy	3 CR
M-ETIT-106067	Power Electronic Systems in Energy Technology	6 CR
M-ETIT-100485	Lighting Engineering	4 CR
M-MACH-105298	Logistics and Supply Chain Management	9 CR
M-INFO-100840	Localization of Mobile Agents	6 CR
M-MACH-101923	Machine Vision	8 CR

M-WIWI-105003	Machine Learning 1	5 CR
M-WIWI-105006	Machine Learning 2	5 CR
M-MACH-102694	Machine Dynamics	5 CR
M-MACH-104984	Material Flow in Logistic Systems	9 CR
M-MACH-102713	Mechanics in Microtechnology	4 CR
M-INFO-100757	Mechano-Informatics and Robotics	4 CR
M-MACH-102699	Laboratory Mechatronics	4 CR
M-INFO-100729	Human Computer Interaction	6 CR
M-INFO-100824	Human-Machine-Interaction in Anthropomatics: Basics	3 CR
M-ETIT-100540	Methods of Signal Processing	6 CR
M-MACH-102714	Microenergy Technologies	4 CR
M-MACH-100487	Microactuators	4 CR
M-MACH-105486	Micro System Simulation	4 CR
M-ETIT-100454	Microsystem Technology	3 CR
M-ETIT-100424	Microwaves Measurement Techniques	4 CR
M-ETIT-100535	Microwave Engineering	5 CR
M-ETIT-100427	Modern Radio Systems Engineering	4 CR
M-MACH-105308	Modern Control Concepts I	4 CR
M-MACH-105313	Modern Control Concepts II	4 CR
M-MACH-105314	Modern Control Concepts III	4 CR
M-INFO-102555	Motion in Human and Machine - Seminar	3 CR
M-INFO-100825	Pattern Recognition	6 CR
M-ETIT-105274	Communications Engineering II	4 CR
M-ETIT-105604	Nano- and Quantum Electronics	6 CR
M-MACH-105292	Novel Actuators and Sensors	4 CR
M-ETIT-100371	Nonlinear Control Systems	3 CR
M-ETIT-100430	Nonlinear Optics	6 CR
M-ETIT-100464	Optical Design Lab	6 CR
M-ETIT-100436	Optical Transmitters and Receivers	6 CR
M-ETIT-100506	Optical Waveguides and Fibers	4 CR
M-ETIT-102310	Optimal Control and Estimation	3 CR
M-ETIT-100531	Optimization of Dynamic Systems	5 CR
M-ETIT-100480	Optoelectronics	4 CR
M-ETIT-100484	Optoelectronic Measurement Engineering	3 CR
M-ETIT-100513	Photovoltaics	6 CR
M-ETIT-105874	Physiology and Anatomy for Biomedical Engineering	6 CR
M-ETIT-100481	Plasma Sources	4 CR
M-ETIT-100475	Plastic Electronics / Polymerelectronics	3 CR
M-MACH-104983	Plug-and-Play Material Handling	4 CR
M-ETIT-104567	Power Electronics	6 CR
M-ETIT-100381	Batteries and Fuel Cells Laboratory	6 CR
M-ETIT-100389	Laboratory Biomedical Engineering	6 CR
M-ETIT-100364	Laboratory Digital Signal Processing	6 CR
M-ETIT-100401	Lab Course Electrical Drives and Power Electronics	6 CR
M-ETIT-102264	Digital Hardware Design Laboratory	6 CR
M-ETIT-100415	Laboratory Information Systems in Power Engineering	6 CR
M-ETIT-103448	Laboratory Mechatronic Measurement Systems	6 CR
M-ETIT-105300	Microwave Engineering Lab	6 CR
M-ETIT-100442	Communications Engineering Laboratory	6 CR
M-ETIT-100468	Lab Course on Nanoelectronics	6 CR

M-ETIT-100478	Laboratory Nanotechnology	6 CR
M-ETIT-100437	Optical Communicatons Laboratory	6 CR
M-ETIT-100477	Laboratory Optoelectronics	6 CR
M-MACH-105291	Lab Computer-Aided Methods for Measurement and Control	4 CR
M-INFO-105955	Practical Course: Smart Energy System Lab	6 CR
M-ETIT-100470	Laboratory FPGA Based Circuit Design	6 CR
M-ETIT-102350	Laboratory Solar Energy	6 CR
M-ETIT-100451	System-on-Chip Laboratory	6 CR
M-MACH-105479	Practical Training in Basics of Microsystem Technology	4 CR
M-ETIT-100394	Practical Aspects of Electrical Drives	4 CR
M-MACH-102718	Product Development – Methods of Product Engineering	6 CR
M-MACH-102711	Production Techniques Laboratory	4 CR
M-ETIT-104475	Project Management in the Development of Products for Safety-Critical Applications	4 CR
M-INFO-105958	Practical Course: Machine Learning and Intelligent Systems	8 CR
M-INFO-102224	Practical Project Robotics and Automation I (Software)	6 CR
M-INFO-102230	Practical Project Robotics and Automation II (Hardware)	6 CR
M-ETIT-105468	Physical and Data-Based Modelling	6 CR
M-MACH-105332	Quality Management	4 CR
M-ETIT-105915	Control of Power-Electronic Systems	6 CR
M-ETIT-100374	Control of Linear Multivariable Systems	6 CR
M-INFO-105623	Reinforcement Learning neu	5 CR
M-WIWI-100500	Renewable Energy-Resources, Technologies and Economics	4 CR
M-INFO-102522	Robotics - Practical Course	6 CR
M-INFO-100893	Robotics I - Introduction to Robotics	6 CR
M-INFO-102756	Robotics II - Humanoid Robotics	3 CR
M-INFO-104897	Robotics III - Sensors and Perception in Robotics	3 CR
M-ETIT-100399	Industrial Circuitry	3 CR
M-MACH-102683	Rail Vehicle Technology	4 CR
M-MACH-102626	Major Field: Integrated Product Development	18 CR
M-MACH-105725	Seamless Engineering	9 CR
M-MACH-105477	Seminar Data-Mining in Production	3 CR
M-ETIT-100455	Seminar Embedded Systems	3 CR
M-MACH-104197	Seminar for Rail System Technology	3 CR
M-ETIT-103447	Seminar Novel Concepts for Solar Energy Harvesting	3 CR
M-ETIT-100428	Seminar Radar and Communication Systems	4 CR
M-ETIT-105607	Seminar on Quantum Detectors and Sensors	3 CR
M-ETIT-100378	Sensors	3 CR
M-ETIT-100450	Software Engineering	3 CR
M-ETIT-100439	Software Radio	3 CR
M-ETIT-100524	Solar Energy	6 CR
M-ETIT-103042	Spaceborne Radar Remote Sensing	6 CR
M-MACH-105348	Control Technology	4 CR
M-INFO-100829	Stochastic Information Processing	6 CR
M-ETIT-105073	Student Innovation Lab	15 CR
M-MACH-105315	System Integration in Micro- and Nanotechnology	4 CR
M-MACH-105316	System Integration in Micro- and Nanotechnology 2	4 CR
M-ETIT-100537	Systems and Software Engineering	5 CR
M-ETIT-100538	Technical Optics	5 CR
M-MACH-105318	Technical Design in Product Development	4 CR
M-MACH-102388	Thermal Solar Energy	4 CR

M-INFO-100839	Fuzzy Sets	6 CR
M-ETIT-100361	Distributed Discrete Event Systems	4 CR
M-MACH-101283	Virtual Engineering A	9 CR
M-MACH-105475	Virtual Engineering Lab	4 CR
M-MACH-105293	Virtual Engineering 1	4 CR
M-MACH-102717	Heat and Mass Transfer	4 CR
M-MACH-102727	Materials for Lightweight Construction	4 CR
M-MACH-105107	Machine Tools and Industrial Handling	8 CR
M-MACH-106050	Reliability and Test Engineering	5 CR

3.5 Interdisciplinary Qualifications

Credits
6

Mandatory		
M-MACH-102755	Engineer's Field of Work	2 CR
Compulsory Elective Modules (Election: at least 4 credits)		
M-ETIT-103248	Key Competences	4 CR

3.6 Additional Examinations

Additional Examinations (Election: at most 30 credits)		
M-INFO-103294	Wearable Robotic Technologies	4 CR
M-INFO-100826	Automated Visual Inspection and Image Processing	6 CR
M-INFO-100814	Biologically Inspired Robots	3 CR
M-MACH-100489	BioMEMS - Microsystems Technologies for Life Sciences and Medicine I	4 CR
M-MACH-100490	BioMEMS - Microsystems Technologies for Life Sciences and Medicine II	4 CR
M-MACH-100491	BioMEMS - Microsystems Technologies for Life Sciences and Medicine III	4 CR
M-MACH-105296	Computational Intelligence	4 CR
M-MACH-102700	Dynamics of the Automotive Drive Train	5 CR
M-MACH-105612	Dynamics of Electro-Mechanical Systems	5 CR
M-ETIT-105916	Real Time Control of Electrical Drives	6 CR
M-INFO-100803	Real-Time Systems	6 CR
M-MACH-105015	Elements of Technical Logistics incl. Project	6 CR
M-MACH-102688	Elements of Technical Logistics	4 CR
M-ETIT-100413	Power Systems and Economy	3 CR
M-MACH-102702	Organ Support Systems	4 CR
M-MACH-105288	Handling Characteristics of Motor Vehicles I	4 CR
M-ETIT-103043	Manufacturing Measurement Technology	3 CR
M-INFO-100753	Design Principles for Interactive Real-Time Systems	3 CR
M-MACH-102690	Fundamentals of Energy Technology	8 CR
M-MACH-100501	Automotive Engineering I	8 CR
M-MACH-100502	Automotive Engineering II	4 CR
M-MACH-102720	Principles of Medicine for Engineers	4 CR
M-MACH-102691	Introduction to Microsystem Technology I	4 CR
M-MACH-102706	Introduction to Microsystem Technology II	4 CR
M-MACH-105283	Basics of Technical Logistics I	4 CR
M-MACH-105824	Fundamentals in the Development of Commercial Vehicles	4 CR
M-MACH-105289	Principles of Whole Vehicle Engineering I	2 CR
M-MACH-105290	Principles of Whole Vehicle Engineering II	2 CR
M-MACH-105302	Basics of Technical Logistics II	6 CR
M-ETIT-100367	Information Technology in Industrial Automation Systems	3 CR
M-MACH-105281	Information Systems and Supply Chain Management	3 CR
M-MACH-105282	IT-Fundamentals of Logistics: Opportunities for Digital Transformation	4 CR
M-MACH-104984	Material Flow in Logistic Systems	9 CR
M-MACH-102714	Microenergy Technologies	4 CR
M-MACH-100487	Microactuators	4 CR
M-MACH-105308	Modern Control Concepts I	4 CR
M-MACH-105313	Modern Control Concepts II	4 CR
M-MACH-105314	Modern Control Concepts III	4 CR
M-MACH-105292	Novel Actuators and Sensors	4 CR
M-ETIT-100513	Photovoltaics	6 CR
M-MACH-104983	Plug-and-Play Material Handling	4 CR
M-ETIT-100401	Lab Course Electrical Drives and Power Electronics	6 CR
M-MACH-105291	Lab Computer-Aided Methods for Measurement and Control	4 CR
M-ETIT-104475	Project Management in the Development of Products for Safety-Critical Applications	4 CR
M-INFO-102224	Practical Project Robotics and Automation I (Software)	6 CR
M-INFO-102230	Practical Project Robotics and Automation II (Hardware)	6 CR
M-MACH-105332	Quality Management	4 CR
M-MACH-105315	System Integration in Micro- and Nanotechnology	4 CR
M-MACH-105318	Technical Design in Product Development	4 CR

M-MACH-102388	Thermal Solar Energy	4 CR
M-MACH-102717	Heat and Mass Transfer	4 CR
M-MACH-105293	Virtual Engineering 1	4 CR
M-ZAK-106099	Supplementary Studies on Sustainable Development neu	19 CR
M-ZAK-106235	Supplementary Studies on Culture and Society neu	22 CR

4 Notes on modules and courses

Level indication for the modules

Level 1 = 1st + 2nd semester Bachelor

Level 2 = 3rd + 4th semester Bachelor

Level 3 = 5th + 6th semester Bachelor

Level 4 = Master

Versions of modules and courses

This specification provides information about the currently valid version of the module or the course. A new version is generated, for example, if an adjustment of the CR was carried out in the module or course. You will automatically receive the valid version in your curriculum. If you have already started a module, you can complete the module in the version you have started (grandfathering).

Course type

Describes the type of competence certificate according to the ETIT study and examination regulations § 4. Competence certificates are subdivided into course works or examinations.

Examinations are graded

1. written examinations,
2. oral examinations, or
3. examinations of another type

Course works are ungraded written, oral, or practical achievements that students usually complete during the course.

Events (lectures, exercises, tutorials, seminars)

In the chapter “Courses” the corresponding events of the current and the previous semester are shown in tabular form. For modules that are not offered every semester, you will thus receive complete information on the associated courses.

Registration and admission to module examinations

In order to take module examinations, students must register for the examination online in the [student portal](#).

In exceptional cases, registration may be made in written form at the *Studierendenservice* (Student Services) or at another facility authorized by the *Studierendenservice*. Registration deadlines for the competence certificates may be set by the examiners.

Where elective options exist, students make a binding declaration of module choice when registering for the examination. Upon application of the student to the examination board, the choice or assignment may be changed subsequently. Each module and competence certificate may be assessed only once in the same degree program.

An examination will be passed, if the grade is at least “sufficient” (4.0).

A module will be passed if all required courses are passed.

5 Publisher

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KIT-Department of Mechanical Engineering

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Module Coordination:

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6 Modules

M

6.1 Module: Actuators and Sensors in Nanotechnology [M-MACH-102698]

Responsible: Prof. Dr. Manfred Kohl

Organisation: KIT Department of Mechanical Engineering

Part of: Field of Specialization / Field of Specialization: Microsystems Technology (Complementary Modules)
Interdisciplinary Subject

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

Mandatory			
T-MACH-105238	Actuators and Sensors in Nanotechnology	4 CR	Kohl

Competence Certificate

oral exam: 45 min

Prerequisites

keine

Competence Goal

- Knowledge of the principles of actuation and sensing
- Knowledge of important fabrication technologies
- Explanation of typical properties (time constants, sensitivities, forces, etc.)
- Explanation of layout and function of the actuators and sensors

Content

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

The lecture includes amongst others the following topics:

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

Workload

Time of attendance: 15 * 1,5 h = 22,5 h
 Preparation and follow up: 15 * 5,5 h = 82,5 h
 Exam Preparation and Exam: 15 h
 Total: 120 h = 4 LP

Recommendation

The lecture addresses students in the fields of mechanical engineering, mechatronics and information technology, materials science and engineering, physics, electrical engineering and economic sciences. A comprehensive introduction is given in the basics and current developments on the nanoscopic length scale.

Literature

- Lecture notes
- 2. Balzani, V., Credi, A., & Venturi, M., Molecular devices and machines: concepts and perspectives for the nanoworld, 2008
- „Nanowires and Nanobelts, - Materials, Properties and Devices -, Volume 2: Nanowires and Nanobelts of Functional Materials“, Edited by Zhong Lin Wang, Springer, 2003, ISBN 10 0-387-28706-X
- „Sensors Based on Nanostructured Materials“, Edited by Francisco J. Arregui, Springer, 2009, ISBN: 978-0-387-77752-8
- “Multivariate Datenanalyse – Methodik und Anwendungen in der Chemie”, R. Henrion, G. Henrion, Springer 1994, ISBN 3-540-58188-X

M**6.2 Module: Advanced Artificial Intelligence [M-INFO-106299]****Responsible:** Prof. Dr. Jan Niehues**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(mandatory\)](#)
[Interdisciplinary Subject](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German/English**Level**
4**Version**
1**Mandatory**

T-INFO-112768	Advanced Artificial Intelligence	6 CR	Niehues
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M**6.3 Module: Analog Circuit Design [M-ETIT-100466]****Responsible:** Prof. Dr. Ivan Peric**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-100973	Analog Circuit Design	4 CR	Peric

M**6.4 Module: Antennas and Multiple Antenna Systems [M-ETIT-100565]**

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-106491	Antennas and Multiple Antenna Systems	5 CR	Zwick

Competence Certificate

The success control takes place within the framework of an oral overall examination (20 minutes).

Prerequisites

The "Antenna and Multiple Antenna Systems" module must not be started or completed.

Competence Goal

The students have in-depth knowledge of antennas and antenna systems. This includes functionality, calculation methods but also aspects of practical implementation. You will be able to understand how any antenna works and to develop and dimension antennas with specified properties.

Content

The lecture teaches the basics of field theory as well as the functioning of all essential antenna structures. The functionality of antenna arrays is also visualized using Matlab exercises. Furthermore, antenna measurement methods are taught, as well as an insight into modern antenna and multi-antenna systems. In addition, a practice-oriented workshop on computer-aided design and simulation of antennas is carried out, in which the students learn to use the software tool CST and thus carry out antenna design tasks independently. Individual antennas are then set up and measured so that the students get to know the entire process.

Module grade calculation

The module grade is the grade of the oral exam.

Workload

Each credit corresponds to approximately 30 hours of work (of the student). This is based on the preferred student who achieves an average performance. The workload includes:

Attendance study time lecture / exercise: 30 h

Attendance study time computer exercise CST / MATLAB: 30h

Self-study time including exam preparation: 90 h

A total of 150 h = 5 LP

M**6.5 Module: Appliance and Power Tool Design [M-MACH-102705]****Responsible:** Prof. Dr.-Ing. Sven Matthiesen**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Internships\)](#)
[Interdisciplinary Subject](#)**Credits**
8**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
3

Mandatory			
T-MACH-105229	Appliance and Power Tool Design	2 CR	Matthiesen
T-MACH-110767	Appliance and Power Tool Design Project Work	6 CR	Matthiesen

Competence Certificate

Oral exam: Duration ca. 40 min.

Final presentation with the results of the project work. 15 min. presentation, 10 min discussion

Prerequisites

None

Competence Goal

The students are able to ...

- analyze complex and contradictory problems regarding the overall system user –machine and hence to create new solutions with focus on customer use.
- list, to identify and to explain strategies and approaches for the design of technical machines, to transfer them on new problems and to evaluate the working results concerning quality, costs and customer use.
- name the impact of specific boundary conditions, e.g. high quantities of mechatronic systems considering the customer, on the resulting design, to interpret the consequences and to evaluate the effects in unknown situations.
- name aspects of a successful product engineering in a team of worldwide acting companies regarding the field customer, company and market.
- evaluate their relevance for self-chosen examples and to transfer them on unknown problems.

Content

Operation system, system of objects and system of objectives of mechatronic appliances and power tool designs.

Mode of operation as enabler of design, components of mechatronic systems, application oriented design, guidelines for appliance and power tool design.

Part of the lecture is a project work, in which theory will be reprocessed and presented in a practical way. In such exercises the students also will present their results developed in project teams.

The interaction of analysis and synthesis will be acquired in student teams at the example of different appliances and power tools.

Module grade calculation

The module grade is composed of:

1. Grade of the oral exam (25%)
2. Grade of project work (75%)

Annotation

Participation in the course on device design requires simultaneous participation in the project work on device technology. For organisational reasons the number of participants is limited. A registration form will be provided on the IPEK homepage at the beginning of August. If the number of applicants is too large, a selection procedure will take place. This is based on the following selection criteria:

- Students within the course of studies will be decided on the basis of their progress (not only with semesters), which will be determined in a personal interview. The personal selection interviews take place in addition, in order to make the students aware of the special project-oriented format and the time required in correlation with the ECTS points of the course before the final registration for the course.
- With the same study progress after waiting period
- With same waiting time by lot.
- The same procedure is used for students from other courses.

Workload

Präsenzzeit Vorlesung: 21 h

Projektarbeit: 195 h

Klausurvorbereitung und Präsenz in selbiger: 24 h

Recommendation

None

Learning type

Lecture, exercise, project work

M**6.6 Module: Applied Information Theory [M-ETIT-100444]****Responsible:** Dr.-Ing. Holger Jäkel**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-100748	Applied Information Theory	6 CR	Jäkel

Prerequisites

none

M**6.7 Module: Artificial Intelligence in Production [M-MACH-105968]****Responsible:** Prof. Dr.-Ing. Jürgen Fleischer**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-112115	Artificial Intelligence in Production	4 CR	Fleischer
T-MACH-112121	Seminar Application of Artificial Intelligence in Production	4 CR	Fleischer

Competence Certificate

T-MACH-112115 - Written Exam (90 min)

T-MACH-112121 - Alternative test achievement (graded)

Competence Goal

The Students understand

- the relevance for the application of artificial intelligence in production and know the main drivers and challenges.
- the CRISP-DM process for implementing AI projects in production.
- the most important methods within the CRISP-DM phases and can theoretically select and practically apply them holistically based on practical issues.

Content

The module AI in Production is designed to teach students the practical, holistic integration of machine learning methods in production. The course is oriented towards the phases of the CRISP-DM process with the aim of developing a deep understanding of the necessary steps and content-related aspects (methods) within the individual phases. In addition to teaching the practical aspects of integrating the most important machine learning methods, the focus is primarily on the necessary steps for data generation and data preparation as well as the implementation and validation of the methods in an industrial environment. The focus of the module is on the practical teaching of the contents, based on production engineering issues. The necessary theoretical basics are taught in the course "Lecture AI in Production". In the course "Project internship Application of AI in Production", practice-relevant architectures of machine learning are used to solve current practical problems in the production environment. The implementation here is also oriented to the phases of the CRISP-DM.

Workload**Artificial Intelligence in Production****MACH:**

regular attendance: 31,5 hours

self-study: 88,5 hours

WING:

regular attendance: 31,5 hours

self-study: 118,5 hours

Seminar Application of Artificial Intelligence in Production

regular attendance: 21 hours

self-study: 99 hours

Learning type

Lecture, Seminar

M**6.8 Module: Automated Manufacturing Systems [M-MACH-105108]****Responsible:** Prof. Dr.-Ing. Jürgen Fleischer**Organisation:** KIT Department of Mechanical Engineering**Part of:** Field of Specialization / Field of Specialization: Industrial Automation (Complementary Modules)
Interdisciplinary Subject

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

Mandatory			
T-MACH-108844	Automated Manufacturing Systems	8 CR	Fleischer

Competence Certificate

oral exam (40 min)

Competence Goal

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.

Content

The module 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 module, 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 module are deepened and applied to concrete problems and tasks.

Workload

1. Presence time lecture/exercise: $15 \cdot 6 \text{ h} = 90 \text{ h}$
 2. Pre- and post-processing time lecture/exercise: $15 \cdot 9 \text{ h} = 135 \text{ h}$
 3. Exam preparation and presence in the same: 15 h
- In total: 240 h = 8 LP

Learning type

Lectures, exercise, field trip

M**6.9 Module: Automated Visual Inspection and Image Processing [M-INFO-100826]****Responsible:** Prof. Dr.-Ing. Jürgen Beyerer**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-INFO-101363	Automated Visual Inspection and Image Processing	6 CR	Beyerer

M**6.10 Module: Automotive Engineering I [M-MACH-100501]****Responsible:** Prof. Dr. Frank Gauterin**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-100092	Automotive Engineering I	8 CR	Gauterin, Unrau

Competence Certificate

written exam; duration approximately 2 hours

Prerequisites

Only one out of the two moduls "M-MACH-100501 - Grundlagen der Fahrzeugtechnik I" and "M-MACH-102686 - Automotive Engineering I" is allowed.

Competence Goal

The students know the movements and the forces at the vehicle and are familiar with active and passive security. They have proper knowledge about operation of engines and alternative drives, the necessary transmission between engine and drive wheels and the power distribution, so that they can apply their knowledge effectively in actual practise. They have an overview of the components necessary for the drive and have the basic knowledge, to analyze, to judge and to develop the complex system "vehicle".

Content

The module provides an overview of:

1. History and future of the automobile
2. Driving mechanics: driving resistances and driving performances, mechanics of the longitudinal and transverse forces, passive safety
3. Engines: combustion engine, alternative drives (e.g. electric motor, fuel cell)
4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)
5. Power transmission and distribution: drive shafts, cardon joints, differentials

Workload

1. regular attendance lecture: $15 * 2 * 2 \text{ h} = 60 \text{ h}$
 2. pre and post processing lecture: $15 * 2 * 3 \text{ h} = 90 \text{ h}$
 3. examination preparation and presence in examination: 90 h
- In total: 240 h = 8 LP

Literature

1. Mitschke, M./ Wallentowitz, H.: Dynamik der Kraftfahrzeuge, Springer-Verlag, Berlin, 2004
2. Braes, H.-H.; Seiffert, U.: Handbuch Kraftfahrzeugtechnik, Vieweg&Sohn Verlag, 2005
3. Gnadler, R.: Script to the lecture 'Automotive Engineering I'

M**6.11 Module: Automotive Engineering II [M-MACH-100502]**

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

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-102117	Automotive Engineering II	4 CR	Gauterin, Unrau

Competence Certificate

Written exam; duration approximately 1,5 h

Prerequisites

none

Competence Goal

The students have an overview of the modules, which are necessary for the road holding of a motor vehicle and the power transmission between vehicle bodywork and roadway. They have knowledge of different wheel suspensions, the tyres, the steering elements and the brakes. They know different execution forms, the function and the influence on the driving or brake behavior. They can apply their knowledge effectively in actual practise. They are able to develop the appropriate components correctly. They are ready to analyze, to judge and to optimize the complex relationship of the different components under consideration of boundary conditions.

Content

The module provides an overview of:

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

Workload

1. regular attendance lecture: $15 * 2 \text{ h} = 30 \text{ h}$
2. pre and postprocessing lecture: $15 * 3 \text{ h} = 45 \text{ h}$
3. examination preparation and presence in examination: 45 h

In total: 120 h = 4 LP

Literature

1. Heiing, B./Ersoy, M.: Fahrwerkhandbuch: Grundlagen, Fahrdynamik, Komponenten, Systeme, Mechatronik, Perspektiven, Vieweg-Verlag, Wiesbaden, 2011
2. Breuer, B./Bill, K.-H.: Bremsenhandbuch: Grundlagen - Komponenten - Systeme - Fahrdynamik, Vieweg-Verlag, Wiesbaden, 2012
3. Gnadler, R.: Script to the lecture 'Automotive Engineering II'

M**6.12 Module: Automotive Vision [M-MACH-102693]**

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

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller

Competence Certificate

Type of Examination: written exam

Duration of Examination: 60 minutes

Prerequisites

none

Competence Goal

After having participated in the lecture the participants have gained knowledge on modern techniques of signal processing and artificial intelligence which can be used to evaluate video sequences, to relate the image content to a spatial context and to interpret the content semantically. This comprises, binocular reconstruction, recognition of movements in video sequences, state space modeling and Bayesian filters, and the recognition of road surfaces and object behavior. The participants have learned to analyze the algorithms mathematically, to implement them in software, and to apply them to tasks in autonomous driving and mobile robots. The participants are able to analyze problems in the areas mentioned before and to develop appropriate solutions.

Content

Machine perception and interpretation of the environment forms the basis for the generation of intelligent behavior. Especially visual perception opens the door to novel automotive applications. Driver assistance systems already improve safety, comfort and efficiency in vehicles. Yet, several decades of research will be required to achieve an automated behavior 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 and advanced information processing techniques are presented to provide a broad overview on seeing vehicles. Application examples from cutting-edge and future driver assistance systems illustrate the discussed subjects. The lecture consists out of 2 hours/week of lecture and 1 hour/week of computer exercises. In the computer exercises methods introduced in the lecture will be implemented in MATLAB and tested experimentally.

Workload

180 hours

composed out of

hours of lecture: 15*3 h = 45 h

preparation time prior to and after lecture: 15*5 h = 75 h

exam preparation and exam: 60 h

Learning type

Lecture

Literature

TBA

M**6.13 Module: Basics of Technical Logistics I [M-MACH-105283]****Responsible:** Prof. Dr.-Ing. Kai Furmans**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-109919	Basics of Technical Logistics I	4 CR	Mittwollen, Oellerich

Competence Certificate

The assessment consists of an oral or a written exam according to Section 4 (2), 1 or 2 of the examination regulation.

Prerequisites

none

Competence Goal

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.

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

Workload

presence: 48h

rework: 72h

Recommendation

Basics knowledge of technical mechanics is preconditioned

Learning type

Lectures

M**6.14 Module: Basics of Technical Logistics II [M-MACH-105302]****Responsible:** Prof. Dr.-Ing. Kai Furmans**Organisation:** KIT Department of Mechanical Engineering**Part of:** **Interdisciplinary Subject**
Additional Examinations**Credits**
6**Grading scale**
Grade to a third**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
2

Mandatory			
T-MACH-109920	Basics of Technical Logistics II	6 CR	Hochstein

Competence Certificate

The assessment consists of an oral or a written exam according to Section 4 (2), 1 or 2 of the examination regulation.

Prerequisites

none

Competence Goal

The student is able to

- describe and design processes and process networks in intralogistics,
- model and analyse the material flow between processes,
- describe material flow elements and apply them in a systematic way,
- check material flow elements for their safety.

Content

The aim of this lecture is to give an overview of the three major topics of technical logistics:

- Processes in intralogistic systems
- Technology of technical logistics
- Organization and control of intralogistic processes

Using the example of an intralogistics system, the various topics are presented over the course of the lecture period, so that students are in the end able to understand and describe such an overall system in detail.

Workload

Attendance: 36 hours

Rework: 114 hours

Recommendation

Basics knowledge of technical logistics I is preconditioned

Learning type

Lectures

M**6.15 Module: Batteries and Fuel Cells [M-ETIT-100532]****Responsible:** Prof. Dr.-Ing. Ulrike Krewer**Organisation:** KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(mandatory\)](#)
[Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
 Interdisciplinary Subject

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

Mandatory			
T-ETIT-100983	Batteries and Fuel Cells	5 CR	Krewer

Prerequisites

none

M**6.16 Module: Batteries and Fuel Cells Laboratory [M-ETIT-100381]****Responsible:** Dr.-Ing. Andre Weber**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Automotive Engineering \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100708	Batteries and Fuel Cells Laboratory	6 CR	Weber

Prerequisites

none

M**6.17 Module: Battery and Fuel Cells Systems [M-ETIT-100377]****Responsible:** Dr.-Ing. Andre Weber**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
Interdisciplinary Subject**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-100704	Battery and Fuel Cells Systems	3 CR	Weber

M**6.18 Module: Bioelectric Signals [M-ETIT-100549]****Responsible:** Dr.-Ing. Axel Loewe**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-101956	Bioelectric Signals	3 CR	Loewe

Competence Certificate

The success control is carried out as part of a written test of 90 minutes.

Prerequisites

none

Module grade calculation

The module grade is the grade of the written exam. The submission of the workshop tasks is a prerequisite for taking the written exam. If there is a very good oral discussion of the workshop tasks, 5 points can be earned for each of the two workshop parts (from 100). The bonus points are only taken into account if the exam is passed. Bonus points do not expire and are retained for examinations that may be taken at a later date. The final assessment of the bonus performance is carried out by the examiner and is documented.

Workload

Attendance time lecture: $8 \cdot 1.5\text{h} = 12\text{h}$

Preparation / follow-up lecture: $8 \cdot 1\text{h} = 8\text{h}$

Workshop tasks: $20\text{h} + 15\text{h} = 35\text{h}$

Exam preparation and attendance in the same: 35h

Total: 90h

Recommendation

Knowledge of the basics of signal processing and physiology is helpful.

Fundamentals of linear electrical networks, Fourier transformation as well as differential equations and systems of linear equations and numerical solution methods

M**6.19 Module: Biologically Inspired Robots [M-INFO-100814]****Responsible:** Prof. Dr.-Ing. Rüdiger Dillmann**Organisation:** KIT Department of Informatics

Part of: [Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-INFO-101351	Biologically Inspired Robots	3 CR	Rönnau

M**6.20 Module: Biomedical Measurement Techniques I [M-ETIT-100387]****Responsible:** Prof. Dr. Werner Nahm**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Medical Technology \(mandatory\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-106492	Biomedical Measurement Techniques I	3 CR	Nahm

Competence Certificate

The assessment takes place in the form of a written examination lasting 60 min. The module grade is the grade of the written exam.

Bonus points can also be awarded. Information on this can be found under "Module grade calculation".

Prerequisites

none

Module grade calculation

The module grade is the grade of the written exam.

Bonus points can also be awarded. The achievement of bonus points works as follows:

- Bonus tasks are solved voluntarily.
- In ILIAS the students wear groups of max. 3 participants for a bonus task.
- The solution to the bonus task must be set in ILIAS at the specified time.
- The solutions are read by the lecture assistants and corrected and approved if necessary.
- The groups present their solutions in the lecture (20 min).
- Lecturers award the bonus points individually for each student based on the written solution and the presentation.
- Each participant can acquire a maximum of 6 bonus points.
- Bonus points can only be earned once.

The bonus points are credited as follows:

- Success control is carried out in a written test (written exam) of 60 min (max. 60 points).
- The exam consists of 6 tasks with 5 points each and 5 tasks with 6 points = 11 tasks.
- For the passed bonus task, a maximum of 6 points can be credited to the exam result.
- The grade can thus be improved by a maximum one step.

The total number of points remains limited to 60 points. The bonus points are only taken into account if the exam is passed. Bonus points do not expire and are retained for any examination achievements taken at a later date.

M**6.21 Module: Biomedical Measurement Techniques II [M-ETIT-100388]****Responsible:** Prof. Dr. Werner Nahm**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-106973	Biomedical Measurement Techniques II	3 CR	Nahm

Competence Certificate

Success is checked in the form of a written test of 60 minutes. The module grade is the grade of the written exam.

Bonus points can also be awarded. You can find information on this under "Module grade".

Prerequisites

The successful participation in the module Biomedical Measurement Techniques I is a prerequisite.

Competence Goal

The students analyzed medical issues and identified measurement tasks. You have proposed a suitable combination of analog circuit technology and digital signal processing and used it to solve the measurement task. They have identified the sources of biosignals and explained the underlying physiological mechanisms. You have analyzed the signal properties and derived the resulting requirements for the measuring system. The students have broken down the measurement chain from the acquisition of the physical measurement variable to the presentation of the medically relevant information and compared alternative concepts.

Content

- physiology
- Sensor technology, physical / chemical measurement technology
- Analog amplification and filtering
- disturbance variables, measurement errors
- Analog-digital conversion, digital signal processing, user interface
- Patient safety, standards, norms

Module grade calculation

The module grade is the grade of the written exam.

Bonus points can also be awarded:

The achievement of bonus points works as follows:

- Bonus tasks are solved voluntarily.
- in ILIAS the students wear groups of max. 3 participants for a bonus task.
- The solution to the bonus task must be set in ILIAS at the specified time.
- The solutions are read by the lecture assistants and corrected and approved if necessary
- the groups present their solutions in the lecture (20 min)
- Lecturers award the bonus points individually for each student based on the written solution and the presentation.
- Each participant can acquire a maximum of 6 bonus points.
- Bonus points can only be earned once.

The bonus points are credited as follows:

- Success control is carried out in a written test (written exam) of 60 min (max. 60 points)
- The exam consists of 6 tasks with 5 points each and 5 tasks with 6 points = 11 tasks
- For the passed bonus task, a maximum of 6 points can be credited to the exam result.

The total number of points remains limited to 60 points.

Annotation

The event is based on an interactive combination of lecture parts and seminar parts. In the seminar part, the participants are asked to independently prepare and present individual topics of the course in small groups. These contributions are evaluated and the students receive bonus points for this. The bonus points are added to the points achieved in the written exam. The sum of the points gives the module grade.

Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

Attendance time in lectures: 2 hours per 15 appointments = 30 hours

Preparation / post-processing of the substance: 4 h each 15 appointments = 60 h

Total effort approx. 90 hours = 3 LP

Recommendation

Basics in physiology. Basics in physical measurement technology, good previous knowledge of analog circuit technology and in digital signal processing.

M**6.22 Module: BioMEMS - Microfluidic Chipsystems V [M-MACH-105484]****Responsible:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-111069	BioMEMS - Microfluidic Chipsystems V	4 CR	Guber, Rajabi

Competence Certificate

Oral exam (20 min)

Prerequisites

none

Competence Goal

The students master the basics of microfluidics. They are able to develop, manufacture and test microfluidic systems in an application-oriented manner. They master applications such as Lab-on-chip, Organ-on-chip, Body-on-chip.

Content

Introduction in microtechnical production processes and biomaterials. Detailed application examples from the fields of lab-on-chip, organ-on-chip and body-on-chip.

Workload

Literature: 19 h

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Learning type

Lecture

Literature

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

M. Madou

Fundamentals of Microfabrication

Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

M**6.23 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine I [M-MACH-100489]****Responsible:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(mandatory\)](#)
[Field of Specialization / Field of Specialization: Medical Technology \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	4 CR	Guber

Competence Certificate

Written exam (75 min)

Prerequisites

none

Competence Goal

The lecture will first address relevant microtechnical manufacturing methods. Then, selected biomedical applications will be presented, as the increasing use of microstructures and microsystems in Life-Sciences and in medicine leads to improved medico-technical products, instruments, and operation and analysis systems.

Content

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

Workload

Literature: 20 h

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature

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

M. Madou

Fundamentals of Microfabrication

Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

M**6.24 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine II [M-MACH-100490]****Responsible:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	4 CR	Guber

Competence Certificate

Written exam (75 min)

Prerequisites

None

Competence Goal

The lecture will first shortly address some relevant microtechnical manufacturing methods. Then, selected biomedical applications will be presented, as the increasing use of microstructures and microsystems in Life-Sciences und in medicine leads to improved medico-technical products, instruments, and operation and analysis systems.

Content

Examples of use in Life-Sciences and biomedicine: Microfluidic Systems:

LabCD, Protein Crystallisation

Microarrays

Tissue Engineering

Cell Chip Systems

Drug Delivery Systems

Micro reaction technology

Microfluidic Cells for FTIR-Spectroscopy

Microsystem Technology for Anesthesia, Intensive Care and Infusion

Analysis Systems of Person's Breath

Neurobionics and Neuroprosthesis

Nano Surgery

Workload

Literature: 20 h

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature

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

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

M. Madou

Fundamentals of Microfabrication

M**6.25 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine III [M-MACH-100491]****Responsible:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	4 CR	Guber

Competence Certificate

Written exam (75 min)

Prerequisites

none

Competence Goal

The lecture will first shortly address some relevant microtechnical manufacturing methods. Then, selected biomedical applications will be presented, as the increasing use of microstructures and microsystems in Life-Sciences und in medicine leads to improved medico-technical products, instruments, and operation and analysis systems.

Content

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

Workload

Literature: 20 h

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature

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

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

M. Madou

Fundamentals of Microfabrication

M**6.26 Module: BioMEMS - Microsystemtechnology for Life-Science and Medicine IV [M-MACH-105483]****Responsible:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-106877	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine IV	4 CR	Guber

Competence Certificate

Oral exam (20 min)

Prerequisites

none

Competence Goal

The students get to know selected areas of application in the life sciences. They will be able to design and develop novel products for different fields of application in the life sciences, as well as implement them in production technology.

Content

Examples from the life science sector: biosensor technology, microfluidic basic structures and systems, micro-assembly, medical implants, micro-process engineering, optofluidics, medical products law.

Workload

Literature: 19 h

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature

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

M. Madou

Fundamentals of Microfabrication

Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

M**6.27 Module: BUS-Controls [M-MACH-105286]****Responsible:** Prof. Dr.-Ing. Marcus Geimer**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
 Interdisciplinary Subject

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

Mandatory			
T-MACH-102150	BUS-Controls	4 CR	Becker, Geimer
T-MACH-108889	BUS-Controls - Advance	0 CR	Geimer

Competence Certificate

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

Prerequisites

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

Competence Goal

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

After the practical oriented lessons the students will be able to visualize the communication structure of different applications, design basic systems and evaluate the complexity of programming of the complete system.

Hereunto the students program in the practical orientated lessons IFM-controllers using the programming environment CoDeSys.

Content

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

Workload

1. Regular attendance: 21 hours
2. Self-study: 9 hours
3. programming: 50 hours
4. Exam and preparation: 40 hours

Recommendation

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

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

Learning type

Lecture, Tutorial

Literature

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

M**6.28 Module: CAE-Workshop [M-MACH-102684]****Responsible:** Prof. Dr.-Ing. Albert Albers**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen

Competence Certificate

Written examination (with practical part on the computer), duration 60 min

Prerequisites

None

Competence Goal

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.

Content

- introduction to the finite element analysis (FEA)
- stress 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 optimization package of Abaqus

Workload

regular attendance: 31.5 h

self-study: 88,5 h

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

discussing and presenting results in small groups

Learning type

Seminar

Literature

The workshop script will be allocated at Ilias.

M**6.29 Module: Channel Coding: Algebraic Methods for Communications and Storage [M-ETIT-105616]**

Responsible: Prof. Dr.-Ing. Laurent Schmalen
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-111244	Channel Coding: Algebraic Methods for Communications and Storage	3 CR	Schmalen

Competence Certificate

The exam is held as an oral exam of approx. 20 min.

Competence Goal

The students are able to analyse and assess problems of algebraic channel coding. They can apply methods of algebraic coding theory in the context of communication systems for data transmission and data storage and are able to assess their implementation. Additionally, they will get knowledge to current research topics and research results.

Content

This course focuses on the formal and mathematical basics for the design of coding schemes in digital communication systems. These include schemes for data transmission, data storage and networking. The course starts by introducing the necessary fundamentals of algebra which are then used to derive codes for different applications. Besides codes that are important for data transmission applications, e.g., BCH and Reed-Solomon-Codes, we also investigate codes for the efficient storage and reconstruction of data in distributed systems (locally repairable codes) and codes that increase the throughput in computer networks (network codes). Real applications are always given to discuss practical aspects and implementations of these coding schemes. Many of these applications are illustrated by example code in software (python/MATLAB).

Module grade calculation

Grade of the module corresponds to the grade of the oral exam.

Workload

1. Attendance to the lecture: $15 * 2 \text{ h} = 30 \text{ h}$
2. Preparation and review: $15 * 4 \text{ h} = 60 \text{ h}$
3. Preparation for the exam: included in preparation and review
4. In total: $90 \text{ h} = 3 \text{ LP}$

Recommendation

Knowledge of basic engineering as well as basic knowledge of communications engineering.

Previous attendance of the lectures "Communication Engineering I" and "Probability Theory" is recommended.

M**6.30 Module: Communication Systems and Protocols [M-ETIT-100539]**

Responsible: Dr.-Ing. Jens Becker
Prof. Dr.-Ing. Jürgen Becker

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: **Interdisciplinary Subject**

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-ETIT-101938	Communication Systems and Protocols	5 CR	Becker, Becker

Competence Certificate

The examination consists of a written examination of 120 min.

Prerequisites

none

Competence Goal

Participants know basic procedures and methods for developing and operating electronic communication systems. Participants know about current communication systems and know about their applications. Boundary conditions of such systems are known and their relevance for a given problem can be assessed. Given the boundary conditions and specifications, the students are able to design communication system by choosing suitable processes, methods, components and subsystems.

Content

The lecture will present the physical and technical basics for the design and construction of communication systems. Procedures and technical implementations for communication between electronic devices are presented. This includes, among other things, modulation methods, line model, arbitration, synchronization mechanisms, error correction mechanisms, multiplexing, communication systems, bus systems and on-chip communication. On the basis of selected practical examples, the application of the lecture contents in real systems is demonstrated.

Module grade calculation

The module grade is the grade of the written exam.

Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

- attendance in 15 lectures and 7 exercises: 33 h
 - preparation / follow-up: 66 h (2 h per unit)
 - preparation of and attendance in examination: 24 h + 2 h
- A total of 125 h = 5 LP

Recommendation

Knowledge of the basics from the lecture „Digitaltechnik“ (Lehrveranstaltung Nr. 23615) is helpful.

M**6.31 Module: Communications Engineering II [M-ETIT-105274]**

Responsible: Dr.-Ing. Holger Jäkel
Prof. Dr.-Ing. Laurent Schmalen

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-110697	Communications Engineering II	4 CR	Jäkel, Schmalen

Competence Certificate

The assessment will be carried out in the form of a written exam of 120 minutes.

Prerequisites

none

Competence Goal

The students are able to analyze even more complex problems in communications engineering. You can independently develop and validate solutions and use problem-solving software. The transfer of the learned methods enables the students to quickly grasp other topics and to work on them with the appropriate methodological knowledge.

Content

The course broadens the questions dealt with in the lecture Communication Engineering I. The focus here is on the detailed analysis of known algorithms and the introduction of new methods that were not discussed in the lecture Communications Engineering I, especially in the areas of system and channel modeling, equalization and synchronization.

Module grade calculation

The module grade is the grade of the written exam.

Annotation

The module can be started for the first time in summer term 2020. Please note: The German course "Nachrichtentechnik II" takes place every summer term (starting summer term 2020) and the English version "Communications Engineering II" takes place every winter term (starting winter term 2020/2021).

Workload

1. Attendance Lecture: $15 * 2 \text{ h} = 30 \text{ h}$
 2. Preparation / Postprocessing Lecture: $15 * 4 \text{ h} = 60 \text{ h}$
 3. Presence Exercise: $15 * 1 \text{ h} = 15 \text{ h}$
 4. Preparation / follow-up Exercise: $15 * 2 \text{ h} = 30 \text{ h}$
 5. Exam preparation and presence in the same: charged in preparation / follow-up
- Total: $135 \text{ h} = 4 \text{ LP}$

Recommendation

Knowledge of basic engineering mathematics including integral transformations and probability theory as well as basic knowledge of communications engineering.

Previous visit to the lecture "Communications Engineering I", "Probability Theory" and "Signals and Systems" is recommended.

M**6.32 Module: Communications Engineering Laboratory [M-ETIT-100442]****Responsible:** Dr.-Ing. Holger Jäkel**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100746	Communications Engineering Laboratory	6 CR	Jäkel

Prerequisites

none

M**6.33 Module: Computational Intelligence [M-MACH-105296]****Responsible:** apl. Prof. Dr. Ralf Mikut**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(mandatory\)](#)
[Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

Credits
 4

Grading scale
 Grade to a tenth

Recurrence
 Each winter term

Duration
 1 term

Language
 German

Level
 4

Version
 1

Mandatory			
T-MACH-105314	Computational Intelligence	4 CR	Mikut, Reischl

Competence Certificate

A performance assessment is obligatory and can be oral, a written exam, or of another kind.

Prerequisites

None

Competence Goal

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

Content

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

Workload

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

Learning type

Lecture

M**6.34 Module: Continuum Mechanics [M-MACH-105180]**

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Prof. Dr.-Ing. Bettina Frohnäpfel

Organisation:

Part of: Interdisciplinary Subject

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

Mandatory			
T-MACH-110377	Continuum Mechanics of Solids and Fluids	4 CR	Böhlke, Frohnäpfel
T-MACH-110333	Tutorial Continuum Mechanics of Solids and Fluids	1 CR	Böhlke, Frohnäpfel

Competence Certificate

written exam, 90 min. The tutorials T-MACH-110333 are prerequisites to the exam.

Prerequisites

none

Competence Goal

After having finished this module the students can list principles of continuum mechanics of solids and fluids. They can apply methods of tensor calculus and analysis in the framework of Continuum Mechanics for concrete examples and name numerical concepts for solving problems in modelling solids and/or fluids. Moreover, the students are able to solve problems in modelling solids and/or fluids using commercial software codes.

Content

This module aims to teach students the theoretical and practical aspects of continuum mechanics of solids and liquids. At the beginning there is an introduction to tensor calculus and kinematics. Then the balance equations of mechanics and thermodynamics are treated. The module gives an overview of the material theory of solids and fluids. This also includes the field equations for solids and fluids. Beyond thermomechanical couplings, the module imparts knowledge in dimensional analysis.

Annotation

none

Workload

1. Attendance lecture and tutorials: $15 \cdot 2 \text{ h} + 15 \cdot 2 \text{ h} = 60 \text{ h}$
2. Preparation and recap of lecture and tutorials: $15 \cdot 3 \text{ h} = 45 \text{ h}$
3. Exam preparation and presence during exam: 45 h

Recommendation

none

Learning type

Lecture, tutorial, consultation hours

Literature

see contained bricks

M**6.35 Module: Control of Linear Multivariable Systems [M-ETIT-100374]**

Responsible: Prof. Dr.-Ing. Sören Hohmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [General Mechatronics](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100666	Control of Linear Multivariable Systems	6 CR	Kluwe

Competence Certificate

Success is checked as part of a written overall test (120 minutes) of the course.

Prerequisites

none

Competence Goal

- The students first acquired basic knowledge of the various forms of description of linear multivariable systems in the frequency and time domain with both time-continuous and time-discrete models.
- In particular, they are able to transform multi-size systems in the state space to different normal forms depending on the requirements.
- The students have an understanding of fundamental properties such as Stability, trajectory profiles, controllability and observability as well as pole / zero configuration are achieved and the systems can analyze them accordingly.
- You master the basic principles for controlling linear multi-variable systems both in the frequency domain (series decoupling) and in the time domain (pole specification with pre-filter)
- In concrete terms, the students are familiar with the design procedures modal control, decoupling control in the time domain and the complete modal synthesis.
- You are familiar with the problem of state quantity determination by state observers and the design of complete and reduced observers.
- Students are able to use advanced concepts such as output feedback and dynamic controllers if necessary.
- You can continue to counter the problems of high model orders in the state space by reducing the order based on the dominance analysis.

Content

The aim is to impart basic and advanced methods for the treatment of linear multi-size systems, the focus being on the state space. In this way, the students are introduced to a model that allows more modern and, in particular, non-linear processes. On the one hand, the module provides a comprehensive overview of the most important aspects in the variable description of the systems and the analysis of their characteristic properties. On the other hand, all facets of the synthesis of regulations for initial and permanent disorders and the observers often required for this are conveyed.

Module grade calculation

The module grade is the grade of the written exam.

Workload

Each credit point corresponds to 30 hours of work (of the student). Fall under the workload

Attendance time in lecture / exercise (3 + 1 SWS: 60h = 2 CP)

Preparation / follow-up lecture / exercise (90h = 3 CP)

Preparation / attendance time written exam (30h = 1 CP)

Recommendation

For a deeper understanding, basic knowledge of system dynamics and control technology is absolutely necessary, as taught in the ETIT Bachelor module "System Dynamics and Control Technology" M-ETIT-102181.

M**6.36 Module: Control of Power-Electronic Systems [M-ETIT-105915]****Responsible:** Dr.-Ing. Andreas Liske**Organisation:** KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

Credits
 6

Grading scale
 Grade to a tenth

Recurrence
 Each summer term

Duration
 1 term

Language
 German

Level
 4

Version
 1

Mandatory			
T-ETIT-111897	Control of Power-Electronic Systems	6 CR	Liske

Prerequisites

none

M**6.37 Module: Control Technology [M-MACH-105348]****Responsible:** Hon.-Prof. Dr. Christoph Gönheimer**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-105185	Control Technology	4 CR	Gönheimer

Competence Certificate

Written Exam (60 min)

Prerequisites

None

Competence Goal

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.

Content

The module control technology gives an integral overview of available control components within the field of industrial production systems.

The first part of the module 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 module ends with the topic of cross-linking and decentralization with the help of bus systems.

The module 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

Workload

regular attendance: 21 hours

self-study: 99 hours

Learning type

Lecture

M**6.38 Module: Control Theory Laboratory [M-ETIT-105467]****Responsible:** Prof. Dr.-Ing. Sören Hohmann**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Internships\)](#)
Interdisciplinary Subject

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

Mandatory			
T-ETIT-111009	Control Theory Laboratory	6 CR	Hohmann

Prerequisites

None

M**6.39 Module: Current Topics on BioMEMS [M-MACH-105485]****Responsible:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)
 Interdisciplinary Subject

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

Mandatory			
T-MACH-102176	Current Topics on BioMEMS	4 CR	Guber

Competence Certificate

Active participation and own presentation (30 Min.).

Prerequisites

none

Competence Goal

The students are able to work on medical-technical or biological topics. They learn the medical and biological basics and are able to transfer them to engineering sciences and find novel technical solutions.

Content

Topics: Minimally invasive surgery, interventional cardiology, implants, biomaterials, sterilization techniques, microanalysis systems

Workload

Literature: 19 h

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Learning type

Project Work

Literature

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

M. Madou

Fundamentals of Microfabrication

Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

M**6.40 Module: Cyber Physical Production Systems [M-ETIT-106039]****Responsible:** Prof. Dr.-Ing. Mike Barth**Organisation:** KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-112223	Cyber Physical Production Systems	4 CR	

Competence Certificate

The examination takes place within the framework of an oral overall examination (20 minutes).

Prerequisites

none

Competence Goal

- The students are familiar with the aspects of Industrie 4.0 and the associated cyber-physical production systems.
- Students will be able to network machines and industrial control systems with each other.
- Students understand the need for advanced methods and services in the field of industrial automation.
- Students are able to model mechatronic production systems and form digital assets.
- Students are able to validate different information models and ontologies for their applicability.
- Students will be able to model data, information and knowledge or extract them from existing systems.
- Students are able to apply artificial intelligence methods in the domain of systems engineering.
- Students are able to conceptualize the networking of machines.
- The students know suitable modeling tools and their application.

Content

- This module is designed to teach students the theoretical and practical aspects of Industrie 4.0.
- This module further provides a definition of the asset administration shell as well as other information models in industrial application.
 - AutomationML
 - Petri nets
 - PLCOpenXML
- Aspects of Cyber Physical Production Systems will be covered as well as their networking in the Industrial Internet of Things.
- Students will learn common IoT protocols such as OPC UA and MQTT.
- The module aims to provide students with an understanding of the basic principles and limitations of artificial intelligence in industrial automation technology.
- The module shows the relevance of the digital twin and the information modeling behind it.
- The module teaches the aspects of the Semantic Web including ontologies and RDF.
- The students learn formal description languages of automation technology.
- The students learn the aspects of the reliability of networked automation systems regarding functional and IT security.
- The module teaches advanced methods of software engineering and architectures for automation technology.

Module grade calculation

The module grade is the grade of the oral exam.

Workload

The workload includes:

1. attendance in lectures and exercises: $15 \times 2 \text{ h} = 30 \text{ h}$
2. preparation / follow-up: $15 \times 4 \text{ h} = 60 \text{ h}$
3. Preparation of the CPS-Demos: 30 h
4. preparation of and attendance in the final presentation: included in preparation and follow-up.

A total of 120 h = 4 CR

Recommendation

Enjoyment and interest in industrial production and automation. Fun with digitalization and virtual engineering in particular. No inhibitions about software and data models.

M**6.41 Module: Decentrally Controlled Intralogistic Systems [M-MACH-102687]****Responsible:** Prof. Dr.-Ing. Kai Furmans**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization](#) / [Field of Specialization: Industrial Automation \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-105230	Decentrally Controlled Intralogistic Systems	4 CR	Furmans, Hochstein

Competence Certificate

The success control takes place as a study achievement in the form of the presentation of the work results (Lego robot and code) as well as a presentation of five to ten minutes and following discussion.

Prerequisites

None

Competence Goal

Students are able to:

- Name and explain the basics of intralogistic conveyor systems
- Describe and explain communication types between decentralized systems
- Apply the basics of project management in subsequent projects
- Developing constructive solutions for mechanical problems
- Implementing designed behavior patterns in a graphical programming language
- Applying the theory learned to a practical problem
- Evaluate solutions developed through group discussions and presentations

Content

This module is designed to teach students theoretical and practical aspects of automated, decentralized intralogistics. Theoretical basics of mechanical engineering and automation technology will be experienced in practice by implementing a model with Lego Mindstorms. In addition, the basics of control engineering are taught and joint development work in small groups as well as thinking with system boundaries are practised. The students plan self-contained parts of an intralogistic circuit that must interact with other systems in order to master a given transport task. This requires a well thought-out design as well as suitable programming and the coordination of common interfaces.

Annotation

number of participants limited

participants will be selected

One course during summer semester in english

Workload

Time of attendance : 2x5x8h = 80h

Self-study: 40h

Total: 120h

Learning type

Seminar

M**6.42 Module: Deep Learning and Neural Networks [M-INFO-104460]****Responsible:** Prof. Dr. Alexander Waibel**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
Interdisciplinary Subject

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

Mandatory			
T-INFO-109124	Deep Learning and Neural Networks	6 CR	Waibel

M**6.43 Module: Deep Learning for Computer Vision I: Basics [M-INFO-105753]****Responsible:** Prof. Dr.-Ing. Rainer Stiefelhagen**Organisation:** KIT Department of Informatics**Part of:** **Interdisciplinary Subject****Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German/English**Level**
4**Version**
1**Mandatory**

T-INFO-111491

Deep Learning for Computer Vision I: Basics

3 CR

Stiefelhagen

Competence Goal

Students should be able to grasp the underlying concepts in the field of deep learning and its various applications.

- Understand the theoretical basis of deep learning
- Understand the Convolutional Neural Networks (CNN)
- Develop basis for the concepts and algorithms used in building and training the CNNs.
- Able to apply deep learning in different computer vision applications.

Content

In recent years tremendous progress has been made in analysing and understanding image and video content. The dominant approach in Computer Vision today are deep learning approaches, in particular the usage of Convolutional Neural Networks.

The lecture introduces the basics, as well as advanced aspects of deep learning methods and their application for a number of computer vision tasks. The following topics will be addressed in the lecture:

- Introduction to Deep Learning
- Convolutional Neural Networks (CNN): Background
- CNNs: basic architectures and learning algorithms
- Object Recognition with CNN
- Image Segmentation with CNN
- Recurrent Neural Networks
- Generating image descriptions (Image Captioning)
- Automatic question answering (Visual Question Answering)
- Generative Adversarial Networks (GAN) and their applications
- Deep Learning platforms and tools

Annotation

The course is partially given in German and English.

M**6.44 Module: Deep Learning for Computer Vision II: Advanced Topics [M-INFO-105755]****Responsible:** Prof. Dr.-Ing. Rainer Stiefelhagen**Organisation:** KIT Department of Informatics**Part of:** [Interdisciplinary Subject](#)

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

Mandatory			
T-INFO-111494	Deep Learning for Computer Vision II: Advanced Topics	3 CR	Stiefelhagen

M**6.45 Module: Design of Electrical Machines [M-ETIT-100515]****Responsible:** Prof. Dr. Martin Doppelbauer**Organisation:** KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
 Interdisciplinary Subject

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

Mandatory			
T-ETIT-100785	Design of Electrical Machines	5 CR	Doppelbauer

Prerequisites

none

Recommendation

Modul: Elektrische Maschinen und Stromrichter

M**6.46 Module: Design Principles for Interactive Real-Time Systems [M-INFO-100753]****Responsible:** Prof. Dr.-Ing. Jürgen Beyerer**Organisation:** KIT Department of Informatics

Part of: [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-INFO-101290	Design Principles for Interactive Real-Time Systems	3 CR	Beyerer



6.47 Module: Design with Plastics [M-MACH-102712]

Responsible: Dipl.-Ing. Markus Liedel

Organisation: KIT Department of Mechanical Engineering

Part of: Interdisciplinary Subject

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

Mandatory			
T-MACH-105330	Design with Plastics	4 CR	Liedel

Competence Certificate

Oral exam, about 20 minutes

Prerequisites

none

Competence Goal

Students will be able to

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

Content

In module Design with Plastics, students learn the structure and properties of plastics, their processing process and their behaviour under environmental conditions. In addition, they deal with aspects of dimensioning in regard to strength and geometry, discuss design guidelines which are suitable for plastics and see several examples. Furthermore, basics regarding the joining of plastic components, structural foams, supporting simulation tools and trends in plastic technology are shown.

Module grade calculation

The module grade is the grade of the oral exam.

Workload

The workload for the lecture "Design with Plastics" is 120 h per semester and consists of the presence during the lectures (21 h), preparation and rework time at home (50 h) and preparation time for the oral exam (49 h).

Recommendation

Polymerengineering I

Learning type

Lectures (Obligatory)

M**6.48 Module: Digital Beam-Forming for Imaging Radar [M-ETIT-105415]****Responsible:** Prof. Dr.-Ing. Thomas Zwick**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-110940	Digital Beam-Forming for Imaging Radar	4 CR	Zwick

Competence Certificate

The examination consists of a written exam (approx. 120 min.) and weekly exercises. The overall impression is rated.

Prerequisites

The basic principles will be repeated in the lecture. The following lectures are helpful for a comprehensive understanding: Radar System Engineering (engl.), Antennen und Mehrantennensysteme, Spaceborne Radar Remote Sensing (engl.), Modern Radio System Engineering (engl.).

Competence Goal

Students have a basic knowledge of antenna arrays, radar, multipath propagation and noise. They understand the principle and functionality of beam shaping and the differences between digital, analog and hybrid beam-forming. They know the theory, methods, and algorithms of beam-forming. They can understand how beam-forming is applied to radar. You can explain basic radar system concepts and summarize the various applications.

Content

The lecture is (inherently) interdisciplinary and ideally suited to teach students how to combine news and radar technology using digital beam shaping. The basic knowledge required for antennas and antenna groups, wave propagation, radar ambiguities and noise are explained in the lecture. This is followed by a detailed presentation of the various radiation shaping algorithms, each with reference to communication and radar systems and with application examples from satellite-based radar systems. Aspects such as digital and hybrid beam shaping, as well as MIMO and equivalent virtual antenna configuration are explained. Accompanying the lecture, exercises on the lecture material are given. These are discussed in a room exercise and the associated solutions are presented in detail. The voluntary computer internship (not relevant to grades) is closely linked to the lecture and the accompanying tutorial. It is based on the theory developed in the lecture and supplements this with practical experience. The tasks calculated in the tutorial as well as the further explanations are reproduced in the computer internship using simulations.

Module grade calculation

The module grade results of the assessment of the written exam and the weekly exercises. Details will be given during the lecture.

Workload

- Attendance time in lectures (1.5 h per 15 dates) and exercises (1.5 h per 7 dates) = 33 h
- Preparation / revision: 15 weeks each 3 h = 45 h
- Exam preparation and presence in the exam: 1 week à 40 h = 40 h
- Total effort approx. 120 hours = 4 LP

Recommendation

Basics of signal processing and radar techniques are useful.

M**6.49 Module: Digital Circuit Design [M-ETIT-100473]****Responsible:** Prof. Dr. Ivan Peric**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1**Mandatory**

T-ETIT-100974	Digital Circuit Design	4 CR	Peric
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M**6.50 Module: Digital Hardware Design Laboratory [M-ETIT-102264]****Responsible:** Prof. Dr.-Ing. Jürgen Becker**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1**Mandatory**

T-ETIT-104570	Digital Hardware Design Laboratory	6 CR	Becker
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Prerequisites

none

Modeled Conditions

The following conditions have to be fulfilled:

1. The module [M-ETIT-102266 - Digital Hardware Design Laboratory](#) must not have been started.

M**6.51 Module: Digital Hardware Design Laboratory [M-ETIT-102266]****Responsible:** Prof. Dr.-Ing. Jürgen Becker**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-104571	Digital Hardware Design Laboratory	6 CR	Becker

Competence Certificate

Control of success is carried out in an oral examination as well as during the laboratory exercises in form of laboratory reports and/or oral interrogations.

Prerequisites

none

Modeled Conditions

The following conditions have to be fulfilled:

1. The module **M-ETIT-102264 - Digital Hardware Design Laboratory** must not have been started.

Competence Goal

The students

- know the practical usage of FPGAs
- are able to efficiently use modern hardware development tools
- know how to describe hardware in VHDL
- can self dependently draft and implement VHDL-Components based on given specifications
- are able to practically apply common concepts and principles in hardware development (e.g. pipelining)

Content

Grouped in teams of two, the students are introduced to the design of complex hardware/software systems. The laboratory takes place in weekly 4 hour laboratory sessions. During the first few sessions, the students are introduced to the implementation of VHDL-components, the usage of modern synthesis and simulation tools as well as basic knowledge on FPGAs.

Based on those fundamentals, students develop the different components of an image processing system in the second part of the laboratory. This includes implementation and testing steps for the individual components as well as the integration to an overall system. Finally, the hardware system can be realized on FPGA-Hardware and tested with live camera images.

Module grade calculation

The module grade is composed of the result of the oral examination and the effected performance during the laboratory sessions (e.g. reports, oral interrogations, etc.).

Annotation

The module ETIT-102264 („Praktikum Entwurf digitaler Systeme“) must not have been started or completed.

Workload

The amount of work is distributed as follows:

- time of presence during the laboratory sessions: 11 sessions with 4h = 44h
- Preparation and wrap-up: 6h per laboratory session = 66h
- Preparation for the examination: 40h

In total 150h (25h per credit point).

Recommendation

Previous knowledge in design and design automation for electronic systems (e.g. from the lectures HSO, No. 2311619 or HMS, No. 2311608) is recommended.

M**6.52 Module: Digital Twin Engineering [M-ETIT-106040]****Responsible:** Prof. Dr.-Ing. Mike Barth**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-112224	Digital Twin Engineering	4 CR	

Competence Certificate

The examination takes place in form of other types of examination. It consists of a model library developed in the course of a semester-long project in the modeling language Modelica and a presentation of the library lasting 25 minutes. The quality of the model library is evaluated within the framework of the criteria: documentation, formal correctness, functionality, usability, HMI and modeling level of detail. The presentation is evaluated as an additional aspects. The overall impression is evaluated.

Prerequisites

none

Competence Goal

- The students will be able to analyze, structure and formally describe problems in the area of object-oriented physical system modeling.
- The students will be able to understand, apply and further develop the Modelica modeling language.
- The students are able to transfer bidirectionally acting systems into a model.
- The students are able to transfer physical equations into the modeling environment.
- The students are able to critically evaluate the different numerical integration methods for their applicability and to use them sensibly.
- The students are able to create system models and co-simulations using functional mockup units.
- The students will be able to implement a real system at the appropriate modeling depth for the task.
- The students will be able to abstract real system properties and, if necessary, decide whether they need to be modeled.
- The students know suitable simulation tools and their application.

Content

- This module is designed to provide students with the theoretical and practical aspects of object-theoretic equation-based modeling.
- This module also provides a definition of the digital twin and its aspects of the management shell.
 - In this context, a classification of simulation models in the I4.0 VWS takes place.
- Both system simulation in the Open Modelica Editor (OME) and co-simulation with Functional Mockup Units (FMU) will be covered.
- Students create a new model library of a mechatronic system in a semester-long project (teams of 3-4 students).
- The module provides an overview of modern system simulation methods based on bidirectional flow and potential modeling.
- Beyond theoretical and practical modeling, the module imparts the knowledge about practice-relevant modeling levels or depths.
- Furthermore, quality standards for simulation models with focus on the engineering of plants/systems are discussed.

Module grade calculation

The assessment of the developed model library and the presentation of the library will be included in the module grade. More details will be given at the beginning of the course.

Workload

The workload includes:

1. attendance in lectures and exercises: $10 \times 1,5 \text{ h} = 15 \text{ h}$
2. preparation / follow-up: $15 \times 2 \text{ h} = 30 \text{ h}$
3. Implementation of the model library: 60 h
4. preparation of and attendance in the final presentation: 15 h

A total of 120 h = 4 CR

M**6.53 Module: Digitalization of Products, Services & Production [M-MACH-105476]****Responsible:** Dr.-Ing. Bernd Pätzold**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-108491	Digitalization of Products, Services & Production	4 CR	Pätzold

Competence Certificate

Alternative exam assessment.

Two presentations in team work and two written compositions.

Prerequisites

None

Competence Goal

Students are able to

- describe the fundamental challenges and objectives of the progressive digitalization of products, service and production. In context of these challenges, students can name and explain the essential terms.
- illustrate the key drivers and fundamental technologies behind the digitalization of products, services and processes.
- describe the challenges of the ongoing digitalization and the corresponding changes in business processes and distinguish between them in regards to time and place. Furthermore, students are able to assign the IT-Architecture and systems to the corresponding process steps.
- highlight the requirement for future information management in networks of product development and production institutions and can clarify how to validated and safeguard the corresponding IT processes.
- to analyze the challenges of digitalization and present potential solution approaches via self-created scenarios for future developments.

Content

- Digitalization of products, services and production in the context of Industry 4.0 .
- Key drivers for ongoing digitalization and their impact on future product development and manufacturing.
- Methods and procedures to design the according transformation process.
- Intensive group discussions of use-case scenarios using practical examples from the industry.

Workload

120 hour

Learning type

Seminar

M**6.54 Module: Distributed Discrete Event Systems [M-ETIT-100361]****Responsible:** Prof. Dr.-Ing. Michael Heizmann**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(mandatory\)](#)
Interdisciplinary Subject**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-100960	Distributed Discrete Event Systems	4 CR	Heizmann

Prerequisites

none

M**6.55 Module: Drive Train of Mobile Machines [M-MACH-105800]****Responsible:** Prof. Dr.-Ing. Marcus Geimer**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
2 terms**Language**
German**Level**
4**Version**
1

Mandatory			
T-MACH-105307	Drive Train of Mobile Machines	4 CR	Geimer, Wydra

Competence Certificate

The final assessment will be an oral examination (appr. 20 min) taking place during the recess period. The examination will be offered in every semester and can be repeated at any regular examination date.

Prerequisites

None

Competence Goal

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

Workload

120 h

Learning type

Lecture

Literature

Literature: Download of lecture slides from ILIAS. Further literature recommendations during lectures.

M**6.56 Module: Dynamics of Electro-Mechanical Systems [M-MACH-105612]****Responsible:** Prof. Dr.-Ing. Alexander Fidlin**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-111260	Dynamics of Electro-Mechanical Systems	5 CR	Altoé, Fidlin

Competence Certificate

Written examination, 120 minutes

Prerequisites

None

Competence Goal

The students are able to describe the dynamical behaviour of electro-mechanical systems using uniform mathematical approach. They are able to analyse interactions between mechanical and electro-mechanical subsystems. They are familiar with the essential retroactive effects, are able to identify them and calculate their impact. The students become acquainted with the basic non-linear effects in the coupled electro-mechanical systems and are able to analyse them by means of appropriate simulation tools.

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 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

Learning type

Lecture and Tutorial

Literature

J. H. Williams: Fundamentals of Applied Dynamics, MIT Press, 2019

M**6.57 Module: Dynamics of the Automotive Drive Train [M-MACH-102700]****Responsible:** Prof. Dr.-Ing. Alexander Fidlin**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105226	Dynamics of the Automotive Drive Train	5 CR	Fidlin

Competence Certificate

A performance assessment is an oral exam (approx. 30 minutes).

Prerequisites

none

Competence Goal

After having attended this lecture students will be able to understand typical vibration phenomena in a vehicle powertrain and to simulate the essential components of the vehicle powertrain including components of the engine steering. The method of the simulation-based concept choice and the necessary interaction between OEMs and the delivering industry is part of the taught knowledge. The students will also gain experience in the application of numerical simulation methods for solving practical problems of torsion vibrations in highly non-linear systems.

Content

Lectures: The concept of a simulation- based optimization of the vehicle powertrain and its components. Modelling of the components of the power system including internal-combustion engine, torsional vibration damper (two mass flywheel, centrifugal force pendulum, internal damper/torsion damped clutch disc), hydrodynamical transformer, gear, Kardan wave, differential, wheels, driving manoeuvre and its appraisal incl. start, neutral gear, approach, acceleration drive, load alteration, gear alteration, shearing force, stop, and different special manoeuvres like change of intentions or misuse.

Exercise: Elementary numerical proceedings to simulate nonlinear dynamic systems. Modelling of the powertrain in a simulation environment SimulationX or MapleSim.

Workload

Each credit point is equivalent to 25-30 hours of workload (per student). This refers to an average student who shows an average performance. The workload is as follows:

time of attendance lectures: 30 h

time of attendance exercise: 30h

self-study including exam preparation: 90 h

total 150 h - 5 credit points

Recommendation

Basic knowledge of the powertrain technology and elementary vibration knowledge are advantageous. The lectures refer to the book

H. Dresig, A. Fidlin: Schwingungen Mechanischer Antriebssysteme, 4. Auflage, Springer: Berlin - Heidelberg - New York, 2020, 655 S., ISBN: 978-3-662-59137-6

Especially chapter 6 and 7 are recommended.

Literature

- Dresig H. Schwingungen mechanischer Antriebssysteme, 2. Auflage, Springer, 2006
- Pfeiffer F., Mechanical System Dynamics, Springer, 2008
- Laschet A., Simulation von Antriebssystemen:Modellbildung der Schwingungssysteme und Beispiele aus der Antriebstechnik, Springer, 1988

M**6.58 Module: Elements of Technical Logistics [M-MACH-102688]****Responsible:** Dr.-Ing. Martin Mittwollen**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-102159	Elements and Systems of Technical Logistics	4 CR	Fischer, Mittwollen

Competence Certificate

The assessment consists of an oral examination (approx. 20min) .

Prerequisites

none

Competence Goal

Students are able to:

- Describe elements and systems of technical logistics,
- Model and calculate structures and functions of special conveying machines,
- Describe interdependence of material flow systems and technique quantitatively and qualitatively and
- Equip material flow systems with appropriate machines.

Content

material flow systems and their (conveying) technical components

mechanical behaviour of conveyors;

structure and function of conveyor machines; elements of intralogistics (belt conveyor, racks, automatic guided vehicles, fan-in, bifurcation, and etc.)

sample applications and calculations in addition to the lectures inside practical lectures

Workload

Lecture and exercise: 4 LP = 120 h

1. Attendance time lecture: 28 h
2. Preparation/follow-up lecture: 56 h
3. Attendance time exercise: 12 h
4. Preparation/follow-up exercise: 24 h

M**6.59 Module: Elements of Technical Logistics incl. Project [M-MACH-105015]****Responsible:** Dr.-Ing. Martin Mittwollen**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-102159	Elements and Systems of Technical Logistics	4 CR	Fischer, Mittwollen
T-MACH-108946	Elements and Systems of Technical Logistics - Project	2 CR	Fischer, Mittwollen

Competence Certificate

The assessment consists of an oral exam (20min) and presentation of performed project and defense (approx. 30min)

Prerequisites

none

Competence Goal

Students are able to:

- Describe elements and systems of technical logistics,
- Model and calculate structures and functions of special conveying machines,
- Describe interdependence of material flow systems and technique quantitatively and qualitatively and
- Equip material flow systems with appropriate machines.

Content

material flow systems and their (conveying) technical components

mechanical behaviour of conveyors;

structure and function of conveyor machines; elements of intralogistics (belt conveyor, racks, automatic guided vehicles, fan-in, bifurcation, and etc.)

sample applications and calculations in addition to the lectures inside practical lectures

Workload

Lecture and exercise: 6 LP = 180 h

1. Attendance time lecture: 28 h
2. Preparation/follow-up lecture: 56 h
3. Attendance time exercise: 12 h
4. Preparation/follow-up exercise: 24 h
5. Attendance time project: 4 h
6. Preparation/follow-up project: 56 h

Learning type

Lecture, tutorial, project

M**6.60 Module: Energy Informatics 1 [M-INFO-101885]****Responsible:** Prof. Dr. Veit Hagenmeyer**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization](#) / [Field of Specialization: Power Engineering \(Complementary Modules\)](#)**Credits**
5**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German/English**Level**
4**Version**
2

Mandatory			
T-INFO-103582	Energy Informatics 1	5 CR	Hagenmeyer
T-INFO-110356	Energy Informatics 1 - Preliminary Work	0 CR	Hagenmeyer

M**6.61 Module: Energy Informatics 2 [M-INFO-103044]****Responsible:** Prof. Dr. Veit Hagenmeyer**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization](#) / [Field of Specialization: Power Engineering \(Complementary Modules\)](#)**Credits**
5**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German/English**Level**
4**Version**
3**Mandatory**

T-INFO-106059	Energy Informatics 2	5 CR	Hagenmeyer
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Modeled Conditions

The following conditions have to be fulfilled:

1. The module [M-INFO-101885 - Energy Informatics 1](#) must have been passed.

M**6.62 Module: Energy Systems Analysis [M-WIWI-100499]**

Responsible: Dr. Valentin Bertsch
Organisation: KIT Department of Economics and Management
Part of: [Interdisciplinary Subject](#)

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

Mandatory			
T-WIWI-102830	Energy Systems Analysis	3 CR	Ardone, Fichtner

Competence Certificate

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

Prerequisites

None.

Competence Goal

The student

- has the ability to understand and critically reflect the methods of energy system analysis, the possibilities of its application in the energy industry and the limits and weaknesses of this approach
- can use select methods of the energy system analysis by her- /himself

Content

1. Overview and classification of energy systems modelling approaches
2. Usage of scenario techniques for energy systems analysis
3. Unit commitment of power plants
4. Interdependencies in energy economics
5. Scenario-based decision making in the energy sector
6. Visualisation and GIS techniques for decision support in the energy sector

Workload

The total workload for this course is approximately 90 hours. For further information see German version.

M**6.63 Module: Engineering Mechanics [M-MACH-103205]**

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Prof. Dr.-Ing. Wolfgang Seemann

Organisation: KIT Department of Mechanical Engineering

Part of: General Mechatronics

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

Mechanical Engineering (Election: at least 5 credits)			
T-MACH-105209	Introduction to Multi-Body Dynamics	5 CR	Seemann
T-MACH-105274	Engineering Mechanics IV	5 CR	Seemann
T-MACH-110375	Mathematical Methods in Continuum Mechanics	4 CR	Böhlke
T-MACH-110376	Tutorial Mathematical Methods in Continuum Mechanics	2 CR	Böhlke

Competence Certificate

A performance assessment in the bricks to be chosen is obligatory and can be an oral or a written exam. For details see eligible bricks

Prerequisites

Application and exam is allowed only in one lecture of this modul (M-MACH-103205 - Technische Mechanik). "T-MACH-105209 - Einführung in die Mehrkörperdynamik", "T-MACH-105274 - Technische Mechanik IV" or "T-MACH-110375 - Mathematische Methoden der Kontinuumsmechanik".

Competence Goal

Introduction to multi-body dynamics: After completing this module, graduates will be able to describe the kinematics of a rigid body using rotational matrices, angular velocities and corresponding derivatives in various reference systems. They can specify holonomic and non-holonomic constraints for closed kinematic chains. In addition, the graduates can derive Newton-Euler's and ie Lagrangian equations and apply the principle of d'Alembert and the principle of virtual power. Finally, they can analyze the structure of the equations of motion.

Engineering Mechanics IV: The graduates can study the kinematics for movements of points and systems. Based on Newton-Euler's axioms they can derive the equations of motion. In addition to classical synthetic methods, graduates can efficiently apply analytical methods with energy expressions as a starting point.

Mathematical methods of continuum mechanics: After completing the module, graduates can perform the essential operations of tensor algebra and tensor analysis for both second and higher-level tensors, in oblique and curvilinear coordinate systems. They can then apply these operations in the description of infinitesimal and finite deformations of continuum mechanical systems. In addition, graduates can specify the transport theorem and balance equations for continuum mechanical systems and use material equations.

Content

Contents of "Introduction to Multi-Body Dynamics": 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 virtual power, Lagrange's equations, Kane's equations, structure of the equations of motion

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

Contents of "Mathematical Methods of Continuum Mechanics": Tensor algebra: vectors; Basis transformation; dyadic product; Tensors of second order and their properties, eigenvalue problems, Theorem of Cayley-Hamilton, invariants; Tensors of higher order, tensor analysis: tensor algebra and analysis in oblique coordinate systems, differentiation of tensor-valued functions. Application of tensor calculus in Continuum Mechanics: kinematics of infinitesimal and finite deformations, transport theorem, balance equations, stress tensor, constitutive equations, initial boundary value problems

Workload

Introduction to Multi-Body Dynamics: presence lecture: $15 * 2 \text{ h} = 30 \text{ h}$, preparation and recap: $15 * 2 \text{ h} = 30 \text{ h}$, exam preparation and presence during exam: 90 h

Engineering Mechanics IV: presence lecture and tutorial: $15 * 2 \text{ h} + 15 * 2 \text{ h} = 60 \text{ h}$, preparation and recap lecture and tutorial: $15 * 2 \text{ h} + 15 * 2 \text{ h} = 60 \text{ h}$, exam preparation and presence during exam: 30 h

Mathematical methods of continuum mechanics: presence lecture and tutorial: $15 * 2 \text{ h} + 8 * 2 \text{ h} = 46 \text{ h}$, preparation and recap lecture and tutorial: $15 * 2 \text{ h} + 8 * 2 \text{ h} = 46 \text{ h}$, exam preparation and presence during exam: 58 h

Learning type

Lecture, Tutorials, Lab Course, Consultation hours

M**6.64 Module: Engineer's Field of Work [M-MACH-102755]**

Responsible: Prof. Dr. Martin Doppelbauer
Prof. Dr.-Ing. Marcus Geimer

Organisation: KIT Department of Mechanical Engineering

Part of: **Interdisciplinary Qualifications (mandatory)**

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

Mandatory			
T-MACH-105721	Engineer's Field of Work	2 CR	Doppelbauer, Geimer

Competence Certificate

written test

Duration 60 minutes

result: passed / not passed

No tools or reference materials may be used during the exam.

Prerequisites

none

Competence Goal

- The students know the characteristics of an industriell working environment.
- They understand the effectiveness of typical structures in companies and the intention of the most relevant business processes.
- They can judge the impact of regulatory framework on their daily work.

Content

- 1. Organization of Companies**
organizational structure, organizational units, managerial structure, organization charts, project organization, relation between superior and staff, board of managing directors, management of the company, supervisory board, advisory board
- 2. Project Management**
definition of project, project manager, project team, primary processes, supporting processes
- 3. Personnel Development**
applications, trainee programs, management career, professional career, career paths in companies, individual career planning, tasks of HR, manpower requirements planning, training, training-on-the-job, tools for human resource management, annual personnel talk, objective agreement
- 4. Scheduling**
Methods for detailed scheduling, network plans, critical path, Gantt-diagram, milestones
- 5. Development Processes**
research, advance development, series development, product marketing, V-model, SPALTEN-model, technical specifications, requirement specifications, clarification, concept, draft, elaboration, validation, verification, documentation, FMEA
- 6. Standards and Laws**
importance of standards, German and international standardization systems, committees, certification
- 7. Commercial Law**
health protection, safety at work, environment protection, product liability, patents
- 8. Calculation, Financial Statement**
contract award estimate, project costing, unit cost, target costs, cost center accounting, cost recording, hourly rates, asset accounting, profit and loss statement
- 9. Governance**
principles of governance (accountability, responsibility, transparency, fairness), leadership (technical, commercial), reviews, boards, audits, codetermination, compliance

Workload

Regular attendance: 15 hours

Self-study: 15 hours

Test and preparation: 30 hours

total: 60 hours = 2 ECTS

Learning type

Lecture

M**6.65 Module: Fabrication Processes in Microsystem Technology [M-MACH-105478]****Responsible:** Dr. Klaus Bade**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-102166	Fabrication Processes in Microsystem Technology	4 CR	Bade

Competence Certificate

Oral exam

Prerequisites

none

Competence Goal

Students of the course can

- outline and discuss a self-selected microtechnical process chain for a submitted microtechnical product or tool
 - Explain process steps in detail
 - Recognize connections between individual process steps
- reflect relevant interdisciplinary knowledge from chemistry, engineering and physics
- Describe typical tools (masks, mould inserts) and their production

Content

The lecture offers a specialization in manufacturing technology for structure generation in microtechnology, preferably with large height or high aspect ratio. For this purpose, the lithographic process chain (UV-, X-ray, electron beam, 2-photon lithography) is presented intensively in the first half of the lecture. Starting with typical substrates and resists, resist processing, exposure and development are treated. Micro electroplating is discussed to build metallic microstructures. In the second half of the lecture, production methods for typical tools such as masks and mold inserts are a main focus. Furthermore, newer concepts for micro- and nanostructuring based on self-organisation are presented.

Throughout the lecture the description of the process steps by simple and deeper reaching models at the interface between engineering, chemistry and physics is used for a deeper understanding. The role of recurring ideas, such as the role of mass transfer or kinetic control in the individual process steps, will be taught and simple rules for process control and plant design will be derived. Attention is drawn to similarities and differences with microelectronic manufacturing processes. Special attention is paid to the interactions between different manufacturing steps in the complex process chain with regard to cause-and-effect. The technically important guarantee of homogeneity in the surface and freedom from defects of the process result is discussed by means of some manufacturing steps.

Translated with www.DeepL.com/Translator (free version)**Workload**

Literature: 19 h

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Learning type

Lecture

Literature

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

M. Madou

Fundamentals of Microfabrication

Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

M**6.66 Module: Field Propagation and Coherence [M-ETIT-100566]****Responsible:** Prof. Dr. Wolfgang Freude**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject****Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
English**Level**
4**Version**
1

Mandatory			
T-ETIT-100976	Field Propagation and Coherence	4 CR	Freude

Competence Certificate

Type of Examination: oral exam

Duration of Examination: approx. 30 minutes

Modality of Exam: Oral examination, usually one examination day per month during the summer and winter terms. An extra questions-and-answers session will be held for preparation if students wish so.

Prerequisites

none

Competence Goal

Presenting in a unified approach the common background of various problems and questions arising in general optics and optical communications

The students

- know the common properties of counting of modes, density of states and the sampling theorem
- comprehend the relationship between propagation in multimode waveguides, mode coupling, MMI and speckles
- can analyze propagation in homogeneous media with respect to system theory, antennas, and the resolution limit of optical instruments
- understand that coherence as a general concept comprises coherence in time, in space and in polarisation
- comprehend the implication of complete spatial incoherence, and what is the radiation efficiency of a source with a diameter smaller than a wavelength (the mathematical Hertzian dipole, for instance)
- can assess when can two incandescent bulbs form an interference pattern in time
- know under which conditions a heterodyne radio receiver, which is based on a non-stationary interference, actually works

Content

The following selection of topics will be presented:

- Light waves, modes and rays: Longitudinal and transverse modes, sampling theorem, counting and density of modes ("states")
- Propagation in multimode waveguides. Near-field and far-field. Impulse response and transfer function. Perturbations and mode coupling. Multimode interference (MMI) coupler. Modal noise (speckle)
- Propagation in homogeneous media: Resolution limit. Non-paraxial and paraxial optics. Gaussian beam. ABCD matrix
- Coherence of optical fields: Coherence function and power spectrum. Polarisation, eigenstates and principal states. Measurement of coherence with interferometers (Mach-Zehnder, Michelson). Self-heterodyne and self-homodyne setups

Module grade calculation

The module grade is the grade of the oral exam.

Workload

total 120 h, hereof 45 h contact hours (30 h lecture, 15 h problem class), and 75 h homework and self-studies

Recommendation

Minimal background required: Calculus, differential equations and Fourier transform theory. Electrodynamics and field calculations or a similar course on electrodynamics or optics is recommended.

Literature

Detailed lecture notes as well as the presentation slides can be downloaded from the IPQ lecture pages. Additional reading:

Born, M.; Wolf, E.: Principles of optics, 6. Aufl. Oxford: Pergamon Press 1980

Ghatak, A.: Optics, 3. Ed. New Delhi: Tata McGraw Hill 2005

Hecht, E.: Optics, 2. Ed. Reading: Addison-Wesley 1974

Hecht, J.: Understanding fiber optics, 4. Ed. Upper Saddle River: Prentice Hall 2002

Iizuka, K.: Elements of photonics, Vol. I and II. New York: John Wiley & Sons 2002

Further textbooks in German (also in electronic form) can be named on request

M**6.67 Module: Fundamentals in the Development of Commercial Vehicles [M-MACH-105824]****Responsible:** Christof Weber**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-111389	Fundamentals in the Development of Commercial Vehicles	4 CR	Weber

Competence Certificate

Oral exam; duration approximately 30 minutes

Prerequisites

None

Competence Goal

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 are able to plan, to steer, and to handle this process. They can apply their knowledge effectively in actual practise. They know that the customer requirements, the technical realisability, the functionality and the economy are important drivers.

They 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.

They 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. They can apply their knowledge effectively in actual practise.

Content

The module provides an overview of:

- 1.1. Introduction, definitions, history
- 1.2. Development tools
- 1.3. Complete vehicle
- 1.4. Cab, bodyshell work
- 1.5. Cab, interior fitting
- 1.6. Alternative drive systems
- 1.7. Drive train
- 1.8. Drive system diesel engine
- 1.9. Intercooled diesel engines
- 2.1. Gear boxes of commercial vehicles
- 2.2. Intermediate elements of the drive train
- 2.3. Axle systems
- 2.4. Front axles and driving dynamics
- 2.5. Chassis and axle suspension
- 2.6. Braking System
- 2.7. Systems
- 2.8. Excursion

Workload

1. regular attendance lecture: $8 * 4 \text{ h} = 32 \text{ h}$

2. pre and postprocessing lecture: $8 * 6 \text{ h} = 48 \text{ h}$

3. examination preparation and presence in examination: 40 h

In total: 120 h = 4 LP (2 semester)

Learning type

Tutorial

Literature

1. SPECKERT, M.; RUF, N.; DRESSLER, K.; MÜLLER, R.; WEBER, C.; WEIHE, S.: Ein neuer Ansatz zur Ermittlung von Erprobungslasten für sicherheitsrelevante Bauteile; Kaiserslautern: Fraunhofer ITWM, 2009, 27 pp.; Berichte des Fraunhofer ITWM, 177; ISSN: 1434-9973
2. SPECKERT, M.; DRESSLER, K.; RUF, N.; MÜLLER, R.; WEBER, C.: Customer Usage Profiles, Strength Requirements and Test Schedules in Truck Engineering, in: Schindler, C. et al. (Eds.): Proceedings of the 1st Commercial Vehicle Technology Symposium (CVT 2010), Shaker Verlag, 2010, S. 298-307
3. TEUTSCH, R. RITTER, J.; WEBER, C.; KOLB, G.; VILCENS, B.; LOPATTA, A.: Einsatz eines Fahrerleitsystems zur Qualitätssteigerung bei der Betriebsfestigkeitserprobung, Proceedings, 1st Commercial Vehicle Technology Symposium Kaiserslautern, 16. – 18. März 2010
4. WEBER, C.; MÜLLER, R.; TEUTSCH, R.; DRESSLER, K.; SPECKERT, M.: A New Way to Customer Loads Correlation and Testing in Truck Engineering of Daimler Trucks, Proceedings of the 1st International Munich Chassis Symposium, chassis.tech, Munich, Germany, 8th - 9th Juni 2010
5. TEUTSCH, R.; WEBER, C.; MÜLLER, R.; SCHON, U.; EPPLER, R.: Einsatzspezifische Erprobung als Baustein zur Verringerung des Fahrzeuggewichts von Lastkraftwagen, DVM-Berichtsband 138, S. 189 – 201, 20



6.68 Module: Fundamentals of Combustion I [M-MACH-102707]

Responsible: Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas

Competence Certificate

Written exam, graded, approx. 3 h

Prerequisites

none

Competence Goal

After completing the course, the students are able to analyze the functionality of technical combustion systems (e.g. piston engines, gas turbines, furnaces). With regard to environmental pollution, students can name the mechanisms of combustion and pollutant formation and assess concepts for reducing pollutants. They can explain the fundamental chemical and physical processes of combustion and name experimental methods for investigating flames. Furthermore, the students can also describe the differences between laminar and turbulent flames and explain the principles of ignition processes.

Content

The lecture gives an overview of the basic terms and phenomena of technical combustion. In a basic chapter, experimental methods for investigating flames are taught. Conservation equations for laminar flames are derived based on scientific phenomena. In addition, the laminar premixed flame and the laminar non-premixed flame are treated as examples. Knowledge of chemical reactions and their description with reaction mechanisms is conveyed. Furthermore, ignition processes are taught. The content of the lecture is deepened in exercises and applied to specific problems and tasks.

Module grade calculation

Grade of the written exam (100%)

Workload

General attendance: 30 h

Preparation time for the lecture: 30 h

General attendance (Tutorial): 30 h

Self-study: 30 h

Recommendation

none

Learning type

Lecture

Exercise course

Literature

Lecture notes,

Combustion - Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, authors: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

M**6.69 Module: Fundamentals of Energy Technology [M-MACH-102690]**

Responsible: Dr. Aurelian Florin Badea
Prof. Dr.-Ing. Xu Cheng

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Power Engineering \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105220	Fundamentals of Energy Technology	8 CR	Badea, Cheng

Competence Certificate

A performance assessment will consist of a written examination of 90 minutes.

Prerequisites

none

Competence Goal

The objective of the module 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.

Content

The following relevant fields of the energy industry are covered:

- Energy demand and energy situation
- Energy types and energy mix
- Basics. Thermodynamics relevant to the energy sector
- Conventional fossil-fired power plants
- Combined Cycle Power Plants
- Cogeneration
- Nuclear energy
- Regenerative energies: hydropower, wind energy, solar energy, other energy systems
- Energy demand structures. Basics of economic efficiency and calculus. Optimization
- Energy storage
- Transport of energy
- Power generation and environment. Future of the energy industry

Module grade calculation

The module grade is the grade of the written examination.

Workload

1. lectures: $15 \cdot 3 \text{ h} = 45 \text{ h}$
 2. preparation for lectures: $15 \cdot 2 \text{ h} = 30 \text{ h}$
 3. tutorials: $15 \cdot 2 \text{ h} = 30 \text{ h}$
 4. preparation for tutorials: $15 \cdot 1 \text{ h} = 15 \text{ h}$
 5. preparation for exam: 120 h
- Total: 240 h = 8 LP

M**6.70 Module: Fuzzy Sets [M-INFO-100839]**

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: [Interdisciplinary Subject](#)

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

Mandatory			
T-INFO-101376	Fuzzy Sets	6 CR	Hanebeck

M**6.71 Module: Handling Characteristics of Motor Vehicles I [M-MACH-105288]****Responsible:** Dr.-Ing. Hans-Joachim Unrau**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105152	Handling Characteristics of Motor Vehicles I	4 CR	Unrau

Competence Certificate

The assessment is carried out as partial exams (according to Section 4(2) of the examination regulation) 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.

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 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 important influencing factors on the driving behaviour and to contribute to the optimization of the handling characteristics.

Content

1. Problem definition: Control loop driver - vehicle - environment (e.g. coordinate systems, modes of motion of the car body and the wheels)
2. Simulation models: Creation from motion equations (method according to D'Alembert, method according to Lagrange, programme packages for automatically producing of simulation equations), model for handling characteristics (task, motion equations)
3. Tyre behavior: Basics, dry, wet and winter-smooth roadway

Workload

The total work load for this module is about 120 Hours (4 Credits). The partition of the work load is carried out according to the credit points of the courses of the module. The work load for courses with 4 credit points is about 120 hours.

Learning type

Lecture

Literature

1. Willumeit, H.-P.: Modelle und Modellierungsverfahren in der Fahrzeugdynamik, B. G. Teubner Verlag, 1998
2. Mitschke, M./Wallentowitz, H.: Dynamik von Kraftfahrzeugen, Springer-Verlag, Berlin, 2004
3. Gnadler, R.; Unrau, H.-J.: Reprint collection to the lecture Handling Characteristics of Motor Vehicles I

M**6.72 Module: Hardware Modeling and Simulation [M-ETIT-100449]**

Responsible: Dr.-Ing. Jens Becker
Prof. Dr.-Ing. Jürgen Becker

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-100672	Hardware Modeling and Simulation	4 CR	Becker, Becker

Competence Certificate

Achievement is examined in the form of a written examination lasting 120 minutes.

Prerequisites

none

Competence Goal

After completing this module, students know the specific challenges of an embedded system. They will have basic and detailed knowledge of the hardware description language VHDL. They are able to model circuit parts and taking into account the characteristics of the time behavior of modeled components. They are able to create test benches for models in order to perform the functional and timing verification. Furthermore, students will have a basic understanding about the principles of simulators, both for digital as well as analog circuit elements. Similarly, they have knowledge about cross-domain models in VHDL-AMS, that include mixed digital, analog and/or mechanical parts. Students understand the basics of fault simulations for the testability of fabricated circuits and are able to derive test vectors. They know the methods of formal verification

Content

Through the support of CAE tools, which spread out quickly in the recent years, the design process of embedded systems could be accelerated significantly. The basic design of embedded systems using CAE tools and hardware description languages is being learned in this lecture. Knowledge about methods for testing and checking the correctness of designs will be received as well as requirements for industrial design automation systems.

Module grade calculation

Grades result from the written respectively the oral examination.

Annotation

During semester written, otherwise oral examination.

From WS 19/20 the module will be managed by Prof. Jürgen Becker and Dr. Jens Becker.

From WS 19/20 the module is offered in WS.

Workload

Each credit point (LP, Credit Points) corresponds around 25-30h of work effort of the student. Hereby we assume an average student with average performance. The workload is covered by: 1. Participating in lectures, tutorials and practical labs. 2. Preparing and wrap up of the above named units 3. Exam preparation and presence.

Recommendation

Lecture „Systems and Software Engineering“ (23605)

M**6.73 Module: Hardware Synthesis and Optimisation [M-ETIT-100452]****Responsible:** Prof. Dr.-Ing. Jürgen Becker**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1**Mandatory**

T-ETIT-100673	Hardware Synthesis and Optimisation	6 CR	Becker
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Competence Certificate

Achievement will be examined in an oral examination (approx. 20 minutes).

Prerequisites

none

M**6.74 Module: Hardware/Software Co-Design [M-ETIT-100453]****Responsible:** Dr.-Ing. Oliver Sander**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100671	Hardware/Software Co-Design	4 CR	Sander

Competence Certificate

Achievement will be examined in an oral examination (approx. 20 minutes).

Prerequisites

none

M**6.75 Module: Heat and Mass Transfer [M-MACH-102717]****Responsible:** Prof. Dr. Ulrich Maas**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105292	Heat and Mass Transfer	4 CR	Maas, Yu

Competence Certificate

Written exam, graded, approx. 3 hours

Prerequisites

none

Competence Goal

The students will have knowledge of the basic processes, laws and calculation methods of heat and mass transfer based on dimension analysis. Further, they can use it to analyze and derive application systems of industrial importance in the fields of mechanical engineering, energy and process engineering.

Content

The lecture gives an overview of stationary and unsteady heat conduction phenomena in homogeneous and composite bodies; such as plates, pipe shells and spherical shells. Molecular diffusion in gases and the analogy between diffusion and heat conduction are thought. The lecture provides an overview of convective, forced heat transfer in pipes / channels with a flow, as well as plates and profiles that are flown over. In addition, the module conveys knowledge of the mass / heat transfer analogy and the multiphase, convective heat transfer (condensation, evaporation), as well as the convective mass transfer is taught. This module is intended to convey to students the theoretical and practical aspects of the radiant heat transport of solids and gases. The content of the lecture is deepened in exercises and applied to specific problems and tasks.

Module grade calculation

Grade of the written exam (100%)

Workload

General attendance: 30 h

Preparation time for the lecture: 30 h

General attendance (Tutorial): 30 h

Self-study: 30 h

Recommendation

none

Learning type

Lecture

Exercise course

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

M**6.76 Module: High-Voltage Technology [M-ETIT-105060]****Responsible:** Dr.-Ing. Rainer Badent**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-110266	High-Voltage Technology	6 CR	Badent

M**6.77 Module: High-Voltage Test Technique [M-ETIT-100417]****Responsible:** Dr.-Ing. Rainer Badent**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-101915	High-Voltage Test Technique	4 CR	Badent

Prerequisites

none

M**6.78 Module: Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy [M-INFO-100725]****Responsible:** Prof. Dr.-Ing. Tamim Asfour**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)

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

Mandatory			
T-INFO-101262	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	3 CR	Asfour, Spetzger

M**6.79 Module: Human Computer Interaction [M-INFO-100729]**

Responsible: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: [Interdisciplinary Subject](#)

Credits
6

Grading scale
Grade to a tenth

Recurrence
Each summer term

Duration
1 term

Language
German

Level
4

Version
1

Mandatory			
T-INFO-101266	Human-Machine-Interaction	6 CR	Beigl
T-INFO-106257	Human-Machine-Interaction Pass	0 CR	Beigl

M**6.80 Module: Human-Machine-Interaction in Anthropomatics: Basics [M-INFO-100824]****Responsible:** Prof. Dr.-Ing. Jürgen Beyerer**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
1**Mandatory**

T-INFO-101361	Human-Machine-Interaction in Anthropomatics: Basics	3 CR	Beyerer, Geisler
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M**6.81 Module: Humanoid Robotics Laboratory [M-INFO-105792]****Responsible:** Prof. Dr.-Ing. Tamim Asfour**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization](#) / [Field of Specialization: Robotics \(Internships\)](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German/English	4	2

Mandatory			
T-INFO-111590	Humanoid Robotics Laboratory	6 CR	Asfour

Competence Goal

- Students will be able to independently understand, structure, analyze, and solve a complex humanoid robotics problem using existing programming skills, alone or in a small team.
- Students can convey complex technical content in a presentation.

Content

In this practical course, a is worked on alone or in small teams with up to 3 students. Questions of humanoid robotics are dealt with, such as semantic scene interpretation, active perception, planning of grasping and manipulation tasks, action representation with motion primitives, and programming by demonstration.

The project work (alone or in groups) is performed largely independently but supported by scientific staff of the H2T. At the end of the practical course, the work has to be documented and presented in a scientific talk.

Annotation

- Internship dates are always by arrangement with the supervising staff member.
- An extension work of the topic as a master thesis is possible in principle.
- The number of participants in this practical course is generally **limited** and varies with the number of available research projects at the institute.

Workload

Practical course with 4 SWS, 6 LP.

6 LP corresponds to ca. 180 hours, thereof

ca. 10h Attendance time in project discussion meetings

ca. 10h Preparation and follow-up of the above

ca. 150h Self-study to work on the topic

ca. 10h Preparation and giving of a scientific presentation

Recommendation

- Very good programming skills in at least one high-level programming language are strongly recommended.
- Attendance of the lectures Robotics 1, Robotics 2, Robotics 3, as well as the robotics practical course are recommended.
- Project-specific recommendations (knowledge of C++, Python, ...) will be announced in the individual project descriptions

M**6.82 Module: Humanoid Robots - Seminar [M-INFO-102561]****Responsible:** Prof. Dr.-Ing. Tamim Asfour**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization](#) / [Field of Specialization: Robotics \(Complementary Modules\)](#)

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

Mandatory			
T-INFO-105144	Humanoid Robots - Seminar	3 CR	Asfour

Competence Certificate

See partial Achievements (Teilleistung)

Prerequisites

See partial Achievements (Teilleistung)

Competence Goal

The students choose a topic from the field of humanoid robotics, e.g. robot design, motion generation, perception or learning. They conduct a literature research on this topic under the guidance of a scientific supervisor. At the end of the semester, they present the results and write a term paper in English in the form of a scientific publication.

Content

The student gained experience with literature research on a current research topic. He/she explored, understood and compared different approaches to a selected scientific problem. The student is able to write a summary of their literature research in the form of a scientific publication in English and to give a scientific talk on it.

Workload

Seminar with 2 SWS, 3 LP

3 LP corresponds to 90 hours, including

45 hours literature research

25 hours manuscript preparation

10 hours preparation of the presentation

10 hours attendance time

Recommendation

Attending the lectures Robotics I – Introduction to Robotics, Robotics II: Humanoid Robotics, Robotics III – Sensors and Perception in Robotics, Mechano-Informatics and Robotics and Wearable Robotic Technologies is recommended.

M**6.83 Module: Industrial Circuitry [M-ETIT-100399]****Responsible:** Dr.-Ing. Andreas Liske**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
1**Mandatory**

T-ETIT-100716	Industrial Circuitry	3 CR	Liske
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Prerequisites

none

Module grade calculation

Die Modulnote ist die Note der mündlichen Prüfung.

M**6.84 Module: Information Fusion [M-ETIT-103264]****Responsible:** Prof. Dr.-Ing. Michael Heizmann**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-106499	Information Fusion	4 CR	Heizmann

Prerequisites

none

M**6.85 Module: Information Processing in Sensor Networks [M-INFO-100895]****Responsible:** Prof. Dr.-Ing. Uwe Hanebeck**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-INFO-101466	Information Processing in Sensor Networks	6 CR	Hanebeck

M**6.86 Module: Information Systems and Supply Chain Management [M-MACH-105281]****Responsible:** Prof. Dr.-Ing. Kai Furmans**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-102128	Information Systems and Supply Chain Management	3 CR	Kilger

Competence Certificate

The assessment consists of an oral exam according to §4 (2), 2 of the examination regulation. It may be a written exam (according to §4 (2), 1 of the examination regulation) in the case of large number of participants.

Prerequisites

none

Competence Goal

Students are able to:

- Describe requirements of logistical processes regarding IT systems,
- Choose information systems to support logistical processes and use them according to the requirements of a supply chain.

Content

- 1) Overview of logistics systems and processes
- 2) Basic concepts of information systems and information technology
- 3) Introduction to IS in logistics: Overview and applications
- 4) Detailed discussion of selected SAP modules for logistics support

Workload

regular attendance: 21 hours

self-study: 69 hours

Learning type

Lectures

Literature

Stadtler, Kilger: Supply Chain Management and Advanced Planning, Springer, 4th edition 2008

M**6.87 Module: Information Technology in Industrial Automation Systems [M-ETIT-100367]****Responsible:** Dr.-Ing. Peter-Axel Bort**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization](#) / [Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-100698	Information Technology in Industrial Automation Systems	3 CR	Bort

Prerequisites

none

M**6.88 Module: Innovative Concepts for Programming Industrial Robots [M-INFO-100791]****Responsible:** Prof. Dr.-Ing. Björn Hein**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-INFO-101328	Innovative Concepts for Programming Industrial Robots	4 CR	Hein

M**6.89 Module: Integrated Intelligent Sensors [M-ETIT-100457]****Responsible:** Prof. Dr. Wilhelm Stork**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-100961	Integrated Intelligent Sensors	3 CR	Stork

Competence Certificate

Achievement will be examined in an oral examination (approx. 20 minutes).

Prerequisites

none

M**6.90 Module: Integrated Systems and Circuits [M-ETIT-100474]****Responsible:** Prof. Dr. Sebastian Kempf**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
Interdisciplinary Subject**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-100972	Integrated Systems and Circuits	4 CR	Kempf

Prerequisites

none

M**6.91 Module: International Production Engineering [M-MACH-105109]**

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

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

Mandatory			
T-MACH-110334	International Production Engineering A	4 CR	Fleischer
T-MACH-110335	International Production Engineering B	4 CR	Fleischer

Competence Certificate

Alternative test achievement (graded):

- Result of the project work and final presentation with weighting 65%
- Oral exam (ca. 15 min) with weighting 35%

Competence Goal

The students ...

- can develop ideas for technical solutions in the environment of production plants in a team and evaluate their feasibility according to technical and economic criteria,
- are capable of selecting the essential components and modules of a production plant and carrying out the necessary calculations,
- can use FEM simulations to predict and evaluate the static and dynamic behavior of an assembly,
- are able to present, plan and assess their own work and decision-making processes,
- are able to apply basic methods of project management in an international environment.

Content

The module "International Production Engineering" offers a practical insight into the development of production plants in an international environment. A student team works on a current and concrete problem in the field of production engineering, which is introduced into the project by an industrial partner who is operating as well in Germany as in China.

As part of the course "International Production Engineering A", the problem will initially be transferred into work packages. According to the elaborated project plan, ideas and concepts for a solution of the problem will be generated and developed. Based on the concepts, the selected solution approach is elaborated and validated, e.g. through simulation, programming and/or design, but always in the context of production technology. The practical implementation of the developed solution is part of the course "International Production Engineering B" during an eight-week research stay in China.

The project will be carried out by the students under the guidance of scientific staff and in cooperation with the industrial partner. The results of the project will be presented and discussed with the project partner in a final presentation (respectively IPE A and B).

More details about the course are discussed in an information event (always in January/February, the exact date is published on the homepage: www.wbk.kit.edu).

The project offers students ...

- the unique opportunity to put the contents of the accompanying lecture into practice in an interdisciplinary and creative context,
- to gain insights into a wide range of development activities relevant for their future careers,
- cooperation with an attractive industrial partner,
- work in a team with other students with competent support from scientific staff,
- first practical experience in project management
- international practical experience.

Workload**IPE A**

1. Presence time lecture: $15 * 2 \text{ h} = 30 \text{ h}$
 2. Pre- and post-processing time lecture: $15 * 5 \text{ h} = 75 \text{ h}$
 3. Exam preparation and presence in the same: 15 h
- In total: 120 h = 4 LP

IPE B

1. Presence time lecture: $15 * 2 \text{ h} = 30 \text{ h}$
 2. Pre- and post-processing time lecture: $15 * 5 \text{ h} = 75 \text{ h}$
 3. Exam preparation and presence in the same: 15 h
- In total: 120 h = 4 LP

M**6.92 Module: Introduction into Energy Economics [M-WIWI-100498]****Responsible:** Prof. Dr. Wolf Fichtner**Organisation:** KIT Department of Economics and Management**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
5**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
4

Mandatory			
T-WIWI-102746	Introduction to Energy Economics	5 CR	Fichtner

Competence Certificate

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

Prerequisites

None

Competence Goal

The student is able to

- characterize and judge the different energy carriers and their peculiarities,
- understand contexts related to energy economics.

Content

1. Introduction: terms, units, conversions
2. The energy carrier gas (reserves, resources, technologies)
3. The energy carrier oil (reserves, resources, technologies)
4. The energy carrier hard coal (reserves, resources, technologies)
5. The energy carrier lignite (reserves, resources, technologies)
6. The energy carrier uranium (reserves, resources, technologies)
7. The final carrier source electricity
8. The final carrier source heat
9. Other final energy carriers (cooling energy, hydrogen, compressed air)

Workload

The total workload for this course is approximately 165.0 hours. For further information see German version.



6.93 Module: Introduction to Microsystem Technology I [M-MACH-102691]

Responsible: Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink

Competence Certificate

Written exam: 60 min

Prerequisites

None

Competence Goal

The lecture gives an introduction into the basics of microsystems technology. In analogy to processes employed in fabrication of microelectronics circuits the core technologies as well as materials for producing microstructures and components are presented. Finally, various techniques for Silicon micromachining are explained and illustrated with examples for micro-components and micro-systems.

Content

- Introduction in Nano- and Microtechnologies
- Silicon and processes for fabricating microelectronics circuits
- Basic physics background and crystal structure
- Materials for micromachining
- Processing technologies for microfabrication
- Silicon micromachining
- Examples

Workload

Time of attendance: 15 * 1,5 h = 22,5 h

Preparation and follow up: 15 * 5,5 h = 82,5 h

Exam Preparation and Exam: 15 h

Total: 120 h = 4 LP

Literature

M. Madou

Fundamentals of Microfabrication

Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

M**6.94 Module: Introduction to Microsystem Technology II [M-MACH-102706]****Responsible:** Prof. Dr. Jan Gerrit Korvink**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink

Competence Certificate

Written exam: 60 min

Prerequisites

none

Competence Goal

The lecture gives an introduction into the basics of microsystems technology. In the first part, methods for lithographic pattern transfer are summarized. Then specific techniques such as the LIGA process, micro-machining, and laser-patterning are explained and examples are given. Finally assembly and packaging methods are presented leading into a discussion of entire microsystems.

Content

- Introduction in Nano- and Microtechnologies
- Lithography
- LIGA-technique
- Mechanical microfabrication
- Patterning with lasers
- Assembly and packaging
- Microsystems

Workload

Time of attendance: 15 * 1,5 h = 22,5 h

Preparation and follow up: 15 * 5,5 h = 82,5 h

Exam Preparation and Exam: 15 h

Total: 120 h = 4 LP

Literature

M. Madou

Fundamentals of Microfabrication

Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

M**6.95 Module: IT-Fundamentals of Logistics: Opportunities for Digital Transformation [M-MACH-105282]**

Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Frank Thomas

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105187	IT-Fundamentals of Logistics	4 CR	Thomas

Competence Certificate

The assessment consists of an oral exam (30 min.) or an written exam (60min.) taking place in the recess period according to § 4 paragraph 2 Nr. 1/2 of the examination regulation.

Prerequisites

none

Competence Goal

The students ...

- can describe the business process models from goods-inbound to goods-outbound based on sound basic knowledge, and derive the corresponding analysis models.
- will learn through the modularisation of the business process elements to think in reusable, adaptive IT components.
- will accomplish excellent work as a highly-motivated employee together in interdisciplinary teams (responses from the industry).

Content

The rapid development of information technology influences business processes drastically.

A strategic IT-orientation for an enterprise without a critical appreciation of worldwide IT-development (where the half-life value of IT for logistic systems knowledge is less than 3 years) is dangerous. The pressure of costs is always in focus. For this purpose the contents of this course, as well as the detailed script will be continuously revised, and the influences on business processes will be shown in practical examples.

Focuses:**System architecture in Material Flow Control Systems (MFCS)**

A guiding principle for a new system architecture for MFC systems is the consideration of making new standardized, functional groups available for re-usability.

Design and application of innovative Material Flow Control Systems (MFCS)

The most important task of the MFCS is the commissioning of conveying systems with driving commands in a way that optimally utilizes the facility and serves the logistics processes on schedule.

Identification of goods – Application in Logistics

Along with business processes, coded information is the link between the flow of information and the flow of materials, and contributes to error prevention in the communication between people and machines.

Data communication in Intra-logistics

Information describes the content of a message that is of value to the recipient.

The recipient can be both a human and a machine.

Business processes for Intra-logistics – Software follows function!

If the business processes from Goods Incoming to Goods Outgoing are adapted with reusable building blocks then capabilities become visible. Against this background the consideration becomes apparent, how, through an innovative software architecture, a reusable building-block based framework can be made.

Therefore applies: Software follows function. And only if all project requirements are documented in the planing phase, and supported together in an inter-disciplinary team - consisting of logistics planners, the customers (users) and the implementation leader (IL).

Software development in accordance with industrial standards

Today's development of object-oriented software, and the increasing penetration of industrial software production with this technology, makes it possible to create system designs that already offer these opportunities in their facility - both for a high degree of reuse and for easier adaptability.

In software development, object-oriented methods are used to improve the productivity, maintainability and software quality. An important aspect of object-orientation is: the objects used are primarily intended to depict the real world.

Workload

regular attendance: 21 hours

self-study: 69 hours

Learning type

Lectures

M**6.96 Module: Key Competences [M-ETIT-103248]****Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** Interdisciplinary Qualifications (Compulsory Elective Modules)**Credits**
4**Grading scale**
pass/fail**Recurrence**
Each term**Duration**
1 term**Language**
German**Level**
4**Version**
4**Election notes**

For self assignment of taken interdisciplinary qualifications of HoC, ZAK or SPZ the courses ('Teilleistungen') with the title 'Self Assignment-HOC-SPZ-ZAK ...' have to be selected according to the grading scale, graded or ungraded. Title and credits of the achievement are adopted.

Students can access the module via the menu item "Exam Registration and Unregistration" at the Study Portal.

Elective Key Competences (Election: at least 1 item as well as at least 4 credits)			
T-MACH-105721	Engineer's Field of Work	2 CR	Doppelbauer, Geimer
T-ETIT-111316	Introduction to the Scientific Method (Seminar, German)	1 CR	Nahm
T-MACH-106460	Leadership in Interdisciplinary Teams	4 CR	Albers, Matthiesen
T-WIWI-100796	Industrial Business Administration	3 CR	Fichtner
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-106738	ProVIL - Product Development in a Virtual Idea Laboratory	4 CR	Albers
T-ETIT-100814	Seminar Project Management for Engineers	3 CR	Noe
T-ETIT-108820	Seminar Project Management for Engineers	3 CR	Day, Noe
T-ETIT-111369	Strategy Derivation for Engineers	3 CR	Arndt
T-ETIT-100754	Seminar Creating a Patent Specification	3 CR	Stork
T-ETIT-111923	Ethics of Technology - ARs ReflectIonis	2 CR	Kühler
T-ETIT-100797	Educational Development for Student Teachers - Basic Level	2 CR	
T-ETIT-111526	Self Assignment-HOC-SPZ-ZAK-graded	2 CR	
T-ETIT-111527	Self Assignment-HOC-SPZ-ZAK-graded	2 CR	
T-ETIT-111528	Self Assignment-HOC-SPZ-ZAK-graded	2 CR	
T-ETIT-111530	Self Assignment-HOC-SPZ-ZAK-ungraded	2 CR	
T-ETIT-111531	Self Assignment-HOC-SPZ-ZAK-ungraded	2 CR	
T-ETIT-111532	Self Assignment-HOC-SPZ-ZAK-ungraded	2 CR	

M**6.97 Module: Lab Computer-Aided Methods for Measurement and Control [M-MACH-105291]**

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

Organisation:

Part of: [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Internships\)](#)
[Field of Specialization / Field of Specialization: Robotics \(Internships\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105341	Lab Computer-Aided Methods for Measurement and Control	4 CR	Stiller

Competence Certificate

Successful passed Colloquia

Prerequisites

none

Competence Goal

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.

Content

1. Digital technology
 2. Digital storage oscilloscope and digital spectrum analyzer
 3. Supersonic computer tomography
 4. Lighting and image acquisition
 5. Digital image processing
 6. Image interpretation
 7. Control synthesis and simulation
 8. Robot: Sensors
 - 9 Robot: Actuating elements and path planning
- The lab comprises 9 experiments.

Workload

120 hours

Recommendation

Basic studies and preliminary examination; basic lectures in automatic control

Learning type

Tutorial

Literature

Instructions to the experiments are available on the institute's website

M**6.98 Module: Lab Course Electrical Drives and Power Electronics [M-ETIT-100401]**

Responsible: Prof. Dr. Martin Doppelbauer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Internships\)](#)
[Field of Specialization / Field of Specialization: Power Engineering \(Internships\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-ETIT-100718	Lab Course Electrical Drives and Power Electronics	6 CR	Doppelbauer

Prerequisites

none

M**6.99 Module: Lab Course Electrical Power Engineering [M-ETIT-100419]**

Responsible: Prof. Dr. Martin Doppelbauer
Prof. Dr.-Ing. Thomas Leibfried

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Power Engineering \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100728	Lab Course Electrical Power Engineering	6 CR	Badent, Doppelbauer, Leibfried

Prerequisites
none

M**6.100 Module: Lab Course on Nanoelectronics [M-ETIT-100468]****Responsible:** Prof. Dr. Sebastian Kempf**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-100757	Lab Course on Nanoelectronics	6 CR	Kempf

Competence Certificate

The control of success takes place in form of the evaluation of a written report (approx. 10-20 pages) which introduces the topic, discusses the execution of the lab course and the scientific results puts the results into the overall context.

Prerequisites

none

Competence Goal

After successful completion of the module, students will be familiar with elementary processes of microsystems and thin-film technology and will be able to optimize the fabrication of thin-film structures independently and without external guidance. In addition, they will be able to analyze and critically evaluate their results using adequate measuring tools. By working on the practical course in small groups, students also acquire or improve their teamwork skills.

Content

The students learn the basic procedures and processes for the fabrication of integrated circuits as they are also used in industry. After an introduction, they work on specified tasks in the clean room and technology laboratory of the Institute for Micro- and Nanoelectronic Systems and work independently on a set of tasks agreed upon in advance with the supervisor. In detail, the students learn the following methods or processes:

- Fabrication of thin films and multilayer systems by sputtering and thermal vapor deposition.
- Fotolithography
- Characterization of the manufactured devices at room temperature and low temperatures.
- Independent analyses, measurements and evaluations of characteristic quantities of the fabricated structures such as critical temperature, residual resistance ratio, current-voltage characteristics, etc.

The results are subsequently summarized by the students in a final report, put into context and critically discussed.

Module grade calculation

The module grade is the grade of the written report.

Annotation

Two weeks block course in lecture-free time

Workload

A workload of approx. 180h is required for the successful completion of the module. This is composed as follows:

- Preparation of the lab course: 20h
- Discussion and lab course planning with supervisor: 10h
- Attendance time in the lab course: 70h
- Preparation of the written report: 80h

Recommendation

Successful completion of the module M-ETIT-103451 - Thin Films: technology, physics and application I or M-ETIT-105608 - Physics, Technology and Applications of Thin Films is recommended.

M**6.101 Module: Laboratory Biomedical Engineering [M-ETIT-100389]****Responsible:** Prof. Dr. Werner Nahm**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Medical Technology \(mandatory\)](#)
[Interdisciplinary Subject](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
2**Mandatory**

T-ETIT-101934	Laboratory Biomedical Engineering	6 CR	Nahm
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Prerequisites

Passed exam of the module "Biomedizinische Messtechnik I".

Modeled Conditions

The following conditions have to be fulfilled:

1. The module [M-ETIT-100387 - Biomedical Measurement Techniques I](#) must have been passed.

M**6.102 Module: Laboratory Digital Signal Processing [M-ETIT-100364]**

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [Field of Specialization / Field of Specialization: Robotics \(Internships\)](#)
 Interdisciplinary Subject

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

Mandatory			
T-ETIT-101935	Laboratory Digital Signal Processing	6 CR	Heizmann

Prerequisites
 none

M**6.103 Module: Laboratory FPGA Based Circuit Design [M-ETIT-100470]****Responsible:** Prof. Dr. Sebastian Kempf**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100759	Laboratory FPGA Based Circuit Design	6 CR	Kempf

Prerequisites

none

M**6.104 Module: Laboratory Information Systems in Power Engineering [M-ETIT-100415]**

Responsible: Prof. Dr.-Ing. Thomas Leibfried
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [Field of Specialization / Field of Specialization: Power Engineering \(Internships\)](#)
[Interdisciplinary Subject](#)

Credits
6

Grading scale
Grade to a tenth

Recurrence
Each summer term

Duration
1 term

Language
German

Level
4

Version
1

Mandatory			
T-ETIT-100727	Laboratory Information Systems in Power Engineering	6 CR	Leibfried

Prerequisites

none

M**6.105 Module: Laboratory Mechatronic Measurement Systems [M-ETIT-103448]**

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [Field of Specialization](#) / [Field of Specialization: Industrial Automation \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-106854	Laboratory Mechatronic Measurement Systems	6 CR	Heizmann

Competence Certificate

The success control is carried out in the form of a written test of 120 minutes. If there are fewer than 20 candidates, an oral exam of around 20 minutes can alternatively take place. The module grade is the grade of the written or oral exam.

Prerequisites

none

Competence Goal

- Students have in-depth knowledge of different methods for measuring objects, especially surfaces.
- Students master different procedures for the metrological recording of objects and know the relevant requirements, procedures and results.
- Students are able to implement procedures for evaluating sensor data from (surface) measuring devices and to evaluate the quality of the measurement result.

Content

A large number of different measuring methods and systems can be used for the quality inspection of technically manufactured objects and their surfaces. Examples are white light interferometry, confocal microscopy and systems based on focus variation. The measurement methods and systems naturally differ in terms of the physical measurement principle used, but also in terms of the evaluation of the raw sensor data recorded.

In this internship, different systems for the metrological recording of (technical) surfaces are presented and their properties are characterized. In the test dates, the students themselves create procedures and algorithms for processing the sensor data in order to obtain information about the desired geometric and / or optical properties of the examined surface. The algorithms obtained are evaluated on the basis of sensor data from exemplary objects and characterized in terms of the quality of the measurement statements achieved.

Module grade calculation

The module grade is the grade of the written or oral exam.

Annotation

The submission of the protocols of all experiments is required for admission to the examination. The quality of the protocols is assessed; for the admission to the exam, the quality must be acceptable. Attendance of all laboratory dates including the introductory event is required. Already in the event of a single unexcused absence, admission to the examination will not be granted.

Workload

Total: approx. 160 hours, of which

1. Attendance time in introductory session: 1.5 hours
2. Preparation of the test dates: 32 h
3. Attendance time in test appointments (8 appointments of 4 hours each): 32 hours
4. Follow-up of the test dates, Creation of the minutes: 32 h
5. Exam preparation and attendance in the same: 60 h

Recommendation

Knowledge from the lectures "Metrology" or "Metrology in Mechatronics" and "Manufacturing Metrology" as well as basic knowledge of programming (e.g. in Matlab, C / C++) are helpful.

M**6.106 Module: Laboratory Mechatronics [M-MACH-102699]**

Responsible: Prof. Dr. Veit Hagenmeyer
 Prof. Dr.-Ing. Wolfgang Seemann
 Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(Internships\)](#)
[Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-105370	Laboratory Mechatronics	4 CR	Hagenmeyer, Seemann, Stiller

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

Competence Goal

The students are able to put the knowledge from the specialization in mechatronics and microsystems technology into practice on an exemplary mechatronic system, a handling system. The students can create an automated object recognition, calculate kinematic systems and realize a communication between different systems (PC, CAN, USB).

Furthermore, the students can integrate the individual parts of a manipulator in teamwork to a functioning overall system.

Content**Part I**

Control, programming and simulation of robots
 CAN-Bus communication
 Image processing / machine vision
 Dynamic simulation of robots in ADAMS

Part II

In a group work, a kinematic system has to be programmed so that it is able to recognize and grip objects fully automatically.

Module grade calculation

The module is not graded. Passing the module is 100% tied to the performance assessment of the partial performance.

Workload

1. Attendance time Lecture: 15 * 2 h = 30h
2. self-study: 15 * 6 h = 90h

Total: 120h = 4 LP

Learning type

Seminar

M**6.107 Module: Laboratory Nanotechnology [M-ETIT-100478]**

Responsible: Prof. Dr. Ulrich Lemmer
Dr.-Ing. Klaus Trampert

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100765	Laboratory Nanotechnology	6 CR	Lemmer

Prerequisites

none

M**6.108 Module: Laboratory Optoelectronics [M-ETIT-100477]****Responsible:** Dr.-Ing. Klaus Trampert**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each term**Duration**
1 term**Language**
German/English**Level**
4**Version**
1**Mandatory**

T-ETIT-100764	Laboratory Optoelectronics	6 CR	Trampert
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Prerequisites

none

M**6.109 Module: Laboratory Solar Energy [M-ETIT-102350]**

Responsible: Dr.-Ing. Bernd Pätzold
 Prof. Dr. Bryce Sydney Richards
 Dr.-Ing. Klaus Trampert

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Power Engineering \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-104686	Laboratory Solar Energy	6 CR	Trampert

Prerequisites
 none

M**6.110 Module: Lighting Engineering [M-ETIT-100485]**

Responsible: Prof. Dr. Cornelius Neumann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100772	Lighting Engineering	4 CR	Neumann

Prerequisites
 none

M**6.111 Module: Lightweight Engineering Design [M-MACH-102696]****Responsible:** Prof. Dr.-Ing. Albert Albers**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt

Competence Certificate

Written examination (90 min)

Prerequisites

none

Competence Goal

The students are able to ...

- evaluate the potential of central lightweight strategies and their application in design processes.
- apply different stiffening 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.

Content

General aspects of lightweight 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.

Workload1. Time of presence lecture: $15 \cdot 2 \text{ h} = 30 \text{ h}$ 2. Prepare/follow-up lecture: $15 \cdot 2 \text{ h} = 30 \text{ h}$

3. Exam preparation and time of presence: 60 h

Total: 120 h = 4 LP

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

M**6.112 Module: Localization of Mobile Agents [M-INFO-100840]****Responsible:** Prof. Dr.-Ing. Uwe Hanebeck**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
Interdisciplinary Subject**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1**Mandatory**

T-INFO-101377	Localization of Mobile Agents	6 CR	Hanebeck
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M**6.113 Module: Logistics and Supply Chain Management [M-MACH-105298]****Responsible:** Prof. Dr.-Ing. Kai Furmans**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
9	Grade to a tenth	Each summer term	1 term	English	4	2

Mandatory			
T-MACH-110771	Logistics and Supply Chain Management	9 CR	Furmans

Competence Certificate

The assessment consists of a 120 minutes written examination (according to §4(2), 1 of the examination regulation).

Prerequisites

None

Competence Goal

The student

- has comprehensive and well-founded knowledge of the central challenges in logistics and supply chain management, an overview of various practical issues and the decision-making requirements and models in supply chains,
- can model supply chains and logistics systems using simple models with sufficient accuracy,
- identifies cause-effect relationships in supply chains,
- is able to evaluate supply chains and logistics systems based on the methods they have mastered.

Content

Logistics and Supply Chain Management provides comprehensive and well-founded fundamentals for the crucial issues in logistics and supply chain management. Within the scope of the lectures, the interaction of different design elements of supply chains is emphasized. For this purpose, qualitative and quantitative description models are used. Methods for mapping and evaluating logistics systems and supply chains are also covered. The lecture contents are enriched by exercises and case studies and partially the comprehension of the contents is provided by case studies. The interacting of the elements will be shown, among other things, in the supply chain of the automotive industry.

Module grade calculation

grade of the module is grades of the exam

Workload

contact hours (1 HpW = 1 h x 15 weeks):

- lecture: 60 h

independent study:

- preparation and follow-up lectures: 90 h
- preparation of case studies: 60 h
- examination preparation: 60 h

total: 270 h

Recommendation

none

Learning type

Lectures, tutorials, case studies.

Literature

Knut Aliche: Planung und Betrieb von Logistiknetzwerken: Unternehmensübergreifendes Supply Chain Management, 2003

Dieter Arnold et. al.: Handbuch Logistik, 2008

Marc Goetschalkx: Supply Chain Engineering, 2011



6.114 Module: Machine Dynamics [M-MACH-102694]

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

Part of: [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-MACH-105210	Machine Dynamics	5 CR	Proppe

Competence Certificate

Written examination

Prerequisites

none

Competence Goal

Students are able to apply engineering-oriented calculation methods in order to model and to understand dynamic effects in rotating machinery. This includes the investigation of runup, stationary operation of rigid rotors including balancing, transient and stationary behavior of flexible rotors, critical speeds, dynamics of slider-crank mechanisms, torsional oscillations.

Content

1. Introduction
2. Machine as mechatronic system
3. Rigid rotors: equations of motion, transient and stationary motion, balancing
4. Flexible rotors: Laval rotor (equations of motion, transient and stationary behavior, critical speed, secondary effects), refined models)
5. Slider-crank mechanisms: kinematics, equations of motion, mass and power balancing

Workload

Lectures and exercises: 32 h

Studies: 118 h

Learning type

Lecture, tutorial

M**6.115 Module: Machine Learning - Foundations and Algorithms [M-INFO-105778]****Responsible:** Prof. Dr. Gerhard Neumann**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization](#) / [Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-INFO-111558	Machine Learning - Foundations and Algorithms	5 CR	Neumann

Competence Certificate

See partial achievements (Teilleistung)

Prerequisites

See partial achievements (Teilleistung)

Competence Goal

- Students acquire knowledge of the basic methods of Machine Learning
- Students acquire the mathematical knowledge to understand the theoretical foundations of Machine Learning
- Students can categorize, formally describe and evaluate methods of Machine Learning
- Students can apply their knowledge to select appropriate models and methods for selected problems in the field of Machine Learning.

Content

The field of Machine Learning has made enormous progress in recent years and good knowledge of Machine Learning is becoming increasingly in demand on the job market. Machine Learning describes the acquisition of knowledge by an artificial system based on experience or data. Rules or certain calculations no longer have to be manually coded but can be extracted from data by intelligent systems.

This lecture provides an overview of essential and current methods of Machine Learning. After reviewing the necessary mathematical background, the lecture primarily deals with algorithms for classification, regression, and density estimation, with a focus on the mathematical understanding of probabilistic methods and neural networks.

Examples of topics include:

- Linear Regression and Classification
- Model Selection, Overfitting, and Regularization
- Bayesian Learning and Gaussian Processes
- Neural Networks, Backpropagation and Optimization
- Graphical Models and Sampling
- Expectation Maximization
- Variational Inference
- Variational Auto-Encoders and Diffusion Models
- Bayesian Neural Networks
- Transfer and Meta Learning
- Hyperparameter Tuning and Auto-ML

Workload

150h

Recommendation

See partial achievements (Teilleistung)

M**6.116 Module: Machine Learning 1 [M-WIWI-105003]****Responsible:** Prof. Dr.-Ing. Johann Marius Zöllner**Organisation:** KIT Department of Economics and Management**Part of:** [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
5**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-WIWI-106340	Machine Learning 1 - Basic Methods	5 CR	Zöllner

Competence Certificate

The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation or an oral exam (20 min) following §4, Abs. 2, 2 of the examination regulation.

The exam takes place every semester and can be repeated at every regular examination date.

Prerequisites

None

Competence Goal

- Students gain knowledge of the basic methods in the field of machine learning.
- Students understand advanced concepts of machine learning and their application.
- Students can classify, formally describe and evaluate methods of machine learning.
- Students can use their knowledge to select suitable models and methods for selected problems in the field of machine learning.

Content

The subject area of machine intelligence and, in particular, machine learning, taking into account real challenges of complex application domains, is a rapidly expanding field of knowledge and the subject of numerous research and development projects.

The lecture "Machine Learning 1" covers both symbolic learning methods such as inductive learning (learning from examples, learning by observation), deductive learning (explanation-based learning) and learning from analogies, as well as subsymbolic techniques such as neural networks, support vector machines, genetic Algorithms and reinforcement learning. The lecture introduces the basic principles as well as fundamental structures of learning systems and the learning theory and examines the previously developed algorithms. The design and operation of learning systems is presented and explained in some examples, especially in the fields of robotics, autonomous mobile systems and image processing.

Workload

The total workload for this module is approximately 150 hours.



6.117 Module: Machine Learning 2 [M-WIWI-105006]

Responsible: Prof. Dr.-Ing. Johann Marius Zöllner

Organisation: KIT Department of Economics and Management

Part of: [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-WIWI-106341	Machine Learning 2 – Advanced Methods	5 CR	Zöllner

Competence Certificate

The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation or an oral exam (20 min) following §4, Abs. 2, 2 of the examination regulation.

The exam takes place every semester and can be repeated at every regular examination date.

Prerequisites

None

Competence Goal

- Students gain knowledge of the basic methods in the field of machine learning.
- Students understand advanced concepts of machine learning and their application.
- Students can classify, formally describe and evaluate methods of machine learning.
- Students can use their knowledge to select suitable models and methods for selected problems in the field of machine learning.

Content

The subject area of machine intelligence and, in particular, machine learning, taking into account real challenges of complex application domains, is a rapidly expanding field of knowledge and the subject of numerous research and development projects.

The lecture "Machine Learning 2" deals with advanced methods of machine learning such as semi-supervised and active learning, deep neural networks (deep learning), pulsed networks, hierarchical approaches, e.g. As well as dynamic, probabilistic relational methods. Another focus is the embedding and application of machine learning methods in real systems.

The lecture introduces the latest basic principles as well as extended basic structures and elucidates previously developed algorithms. The structure and the mode of operation of the methods and methods are presented and explained by means of some application scenarios, especially in the field of technical (sub) autonomous systems (robotics, neurorobotics, image processing, etc.).

Workload

The total workload for this module is approximately 150 hours.

M**6.118 Module: Machine Tools and Industrial Handling [M-MACH-105107]****Responsible:** Prof. Dr.-Ing. Jürgen Fleischer**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(mandatory\)](#)
 Interdisciplinary Subject

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

Mandatory			
T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems	8 CR	Fleischer

Competence Certificate

Oral exam (40 minutes)

Competence Goal

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.

Content

The module gives an overview of the construction, use and application of machine tools and high-precision manufacturing systems. In the course of the module 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 module 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

Workload

1. Presence time lecture/exercise: $15 \cdot 6 \text{ h} = 90 \text{ h}$
 2. Pre- and post-processing time lecture/exercise: $15 \cdot 9 \text{ h} = 135 \text{ h}$
 3. Exam preparation and presence in the same: 15 h
- In total: $240 \text{ h} = 8 \text{ LP}$

Learning type

Lecture, exercise, field trip

M**6.119 Module: Machine Vision [M-MACH-101923]**

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

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization](#) / [Field of Specialization: Robotics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-MACH-105223	Machine Vision	8 CR	Lauer, Stiller

Competence Certificate

Type of Examination: written exam
Duration of Examination: 60 minutes

Prerequisites

None

Competence Goal

After having participated in the lecture the participants have gained knowledge on modern techniques of machine vision and pattern recognition which can be used to evaluate camera images. This especially includes techniques in the areas of gray level image analysis, analysis of color images, segmentation of images, describing the geometrical relationship between the image and the 3-dimensional world, and pattern recognition with various classification techniques. The participants have learned to analyze the algorithms mathematically, to implement them in software, and to apply them to tasks in video analysis. The participants are able to analyze real-world problems and to develop appropriate solutions.

Content

The lecture on machine vision covers basic techniques of machine vision. It focuses on the following topics:

image preprocessing

edge and corner detection

curve and parameter fitting

color processing

image segmentation

camera optics

pattern recognition

deep learning

Image preprocessing:

The chapter on image processing discusses techniques and algorithms to filter and enhance the image quality. Starting from an analysis of the typical phenomena of digital camera based image capturing the lecture introduces the Fourier transform and the Shannon-Nyquist sampling theorem. Furthermore, it introduces gray level histogram based techniques including high dynamic range imaging. The discussion of image convolution and typical filters for image enhancement concludes the chapter.

Edge and corner detection:

Gray level edges and gray level corners play an important role in machine vision since gray level edges often reveal valuable information about the boundaries and shape of objects. Gray level corners can be used as feature points since they can be identified easily in other images. This chapter introduces filters and algorithms to reveal gray level edges and gray level corners like the Canny edge detector and the Harris corner detector.

Curve and parameter fitting:

In order to describe an image by means of geometric primitives (e.g. lines, circles, ellipses) instead of just pixels robust curve and parameter fitting algorithms are necessary. The lecture introduces and discusses the Hough transform, total least sum of squares parameter fitting as well as robust alternatives (M-estimators, least trimmed sum of squares, RANSAC)

Color processing:

The short chapter on color processing discusses the role of color information in machine vision and introduces various models for color understanding and color representation. It concludes with the topic of color consistency.

Image Segmentation:

Image segmentation belongs to the core techniques of machine vision. The goal of image segmentation is to subdivide the image into several areas. Each area shares common properties, i.e. similar color, similar hatching, or similar semantic interpretation. Various ideas for image segmentation exist which can be used to create more or less complex algorithms. The lecture introduces the most important approaches ranging from the simpler algorithms like region growing, connected components labeling, and morphological operations up to highly flexible and powerful methods like level set approaches and random fields.

Camera optics:

The content of an image is related by the optics of the camera to the 3-dimensional world. In this chapter the lecture introduces optical models that describe the relationship between the world and the image including the pinhole camera model, the thin lens model, telecentric cameras, and catadioptric sensors. Furthermore, the lecture introduces camera calibration methods that can be used to determine the optical mapping of a real camera.

Pattern recognition:

Pattern recognition aims at recognizing semantic information in an image, i.e. not just analyzing gray values or colors of pixels but revealing which kind of object is shown by the pixels. This task goes beyond classical measurement theory and enters the large field of artificial intelligence. Rather than just being developed and optimized by a programmer, the algorithms are adapting themselves to their specific task using training algorithms that are based on large collections of sample images.

The chapter of pattern recognition introduces standard techniques of pattern recognition in the context of image understanding like the support vector machine (SVM), decision trees, ensemble and boosting techniques. It combines those classifiers with powerful feature representation techniques like the histogram of oriented gradients (HOG) features, locally binary patterns (LBP), and Haar features.

Deep learning:

Throughout recent years standard pattern recognition techniques have more and more been outperformed by deep learning techniques. Deep learning is based on artificial neural networks, a very generic and powerful form of a classifier. The lecture introduces multi layer perceptrons as the most relevant form of artificial neural networks, discusses training algorithms and strategies to achieve powerful classifiers based on deep learning including deep auto encoders, convolutional networks, and multi task learning, among others.

Workload

240 hours, composed out of

hours of lecture: $15 \cdot 4 \text{ h} = 60 \text{ h}$

preparation time prior to and after lecture: $15 \cdot 6 \text{ h} = 90 \text{ h}$

exam preparation and exam: 90 h

Learning type

Lecture

Literature

Main results are summarized in the slides that are made available as pdf-files. Further recommendations will be presented in the lecture.

M**6.120 Module: Major Field: Integrated Product Development [M-MACH-102626]****Responsible:** Prof. Dr.-Ing. Albert Albers**Organisation:** KIT Department of Mechanical Engineering**Part of:** Interdisciplinary Subject

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

Mandatory			
T-MACH-105401	Integrated Product Development	18 CR	Albers, Albers Assistenten

Competence Certificate

oral examination (60 minutes)

Prerequisites

None

Competence Goal

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

Content

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

Personal integration: team development and leadership

Guest lectures from the industry

Annotation

The participation in the course "Integrated Product Development" requires the simultaneous participation in the lecture(2145156), the workshop (2145157) and the product development project (2145300).

For organizational reasons, the number of participants for the product development project is limited. Therefore, a selection process will take place. Registration for the selection process is made by means of a registration form, which is available annually from April to July on the homepage of the IPEK. Afterwards the selection itself will be discussed in personal interviews with Professor Albers.

The rule here is:

- Students within the course of studies will be decided on the basis of their progress (not only with semesters), which will be determined in a personal interview. The personal selection interviews take place in addition, in order to make the students aware of the special project-oriented format and the time required in correlation with the ECTS points of the course before the final registration for the course.
- With the same study progress after waiting period
- With same waiting time by lot.
- The same procedure is used for students from other courses.

Workload

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

Learning type

lecture

tutorial

product development project

M**6.121 Module: Manufacturing Measurement Technology [M-ETIT-103043]****Responsible:** Prof. Dr.-Ing. Michael Heizmann**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-106057	Manufacturing Measurement Technology	3 CR	Heizmann

Prerequisites

none

M**6.122 Module: Master's Thesis [M-ETIT-103253]**

Responsible: Prof. Dr. Martin Doppelbauer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [Master's Thesis](#)

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

Mandatory			
T-ETIT-106463	Master's Thesis	30 CR	Doppelbauer

Modeled Conditions

The following conditions have to be fulfilled:

1. You need to have earned at least 75 credits in the following fields:
 - General Mechatronics
 - Interdisciplinary Subject
 - Interdisciplinary Qualifications
 - Field of Specialization
 - Field of Specialization

Competence Goal

After successful completion of the module, students are able to work independently on a challenging task in the field of mechatronics or information technology within a given period of time using scientific methods and in compliance with the rules of good scientific practice under guidance and by applying the theoretical and methodological knowledge acquired in the Master's program. Students are able to do research, analyze and abstract the information and to compile and recognize basic principles and laws from less structured information. Students are able to get an overview of a problem, select complex scientific methods and procedures and use them to find solutions or show further potentials. In principle, this also takes into account social and/or ethical aspects.

The students are able to interpret and evaluate their results. They are also able to document their results in a clearly structured, written elaboration using the appropriate technical terminology. Furthermore, students are able to present and defend their results in front of a scientific audience. They have also deepened their problem-solving skills and their competence in transferring the theoretical and methodological knowledge of mechatronics and information technology into concrete applications.

In addition to the subject-related qualification goals, the students also gain knowledge and experience in the areas of project management as well as self and time management. This also includes knowledge and methods of various presentation techniques.

Content

The students work independently and with scientific methods on a research topic agreed with the subject examiner, which deals with a problem from the area of the Master's program in Mechatronics and Information Technology.

Module grade calculation

The Master's Thesis is written by at least one university lecturer or one senior scientist according to § 14 para. 3 no. 1 KITG and another examiner. As a rule, one of the examiners is Person who has awarded the work in accordance with paragraph 2. If the assessment of these two people does not match, the examination board determines the grade of the Master's Thesis in the context of the assessment of these two persons; he can too order another appraiser. The assessment must be completed within eight weeks of the submission of the Master's Thesis respectively. Section 14 of the study and examination regulations (SPO) regulates further details.

The module grade consists of the Master's Thesis and a presentation (SPO §14, 1b).

M**6.123 Module: Material Flow in Logistic Systems [M-MACH-104984]****Responsible:** Prof. Dr.-Ing. Kai Furmans**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization](#) / [Field of Specialization: Industrial Automation \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-102151	Material Flow in Logistic Systems	9 CR	Furmans

Competence Certificate

The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
 - 40% assessment of the result of the case studies as group work,
 - 20% assessment of the oral examination during the case study colloquiums as individual performance.

A detailed description of the learning control can be found under Annotations.

Prerequisites

none

Competence Goal

The student

- acquires comprehensive and well-founded knowledge on the main topics of logistics, an overview of different logistic questions in practice and knows the functionality of material handling systems,
- is able to illustrate logistic systems with adequate accuracy by using simple models,
- is able to realize coherences within logistic systems,
- is able to evaluate logistic systems by using the learnt methods.

Content

The module *Material Flow in Logistic Systems* provides comprehensive and well-founded basics for the main topics of logistics. Within the lectures, the interaction between several components of logistic systems will be shown. The module focuses on technical characteristics of material handling systems as well as on methods for illustrating and evaluating logistics systems. To gain a deeper understanding, the course is accompanied by exercises and case studies.

Annotation

Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. In the oral examination during the case study colloquiums, the understanding of the result of the group work and the models dealt with in the course is tested. The participation in the oral defenses is compulsory and will be controlled. For the written submission the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

Recommendation

Recommended elective subject: Probability Theory and Statistics

Learning type

Lecture, tutorial

M**6.124 Module: Materials [M-ETIT-102734]**

Responsible: Prof. Dr. Martin Doppelbauer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [General Mechatronics](#)

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

Materials (Election: 1 item)			
T-MACH-100531	Systematic Materials Selection	5 CR	Dietrich, Schulze
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	5 CR	Henning
T-ETIT-109292	Electrical Engineering Components	6 CR	Kempf

Prerequisites

Application and exam is allowed only in one lecture of this modul (M-ETIT-102734 - Werkstoffe): "T-ETIT-109292 - Bauelemente der Elektrotechnik" or " T-MACH-100531 - Systematische Werkstoffauswahl" or "T-MACH-105535 - Faserverstärkte Kunststoffe ..."

Annotation

The three parts of the module "M-ETIT-102734 - Materials" are mutually exclusive

Course „Passive Bauelemente“ will be taught in Wintersemester 2020/21 for the last time.Replacement will be "Bauelemente der Elektrotechnik".

M**6.125 Module: Materials for Lightweight Construction [M-MACH-102727]****Responsible:** Dr.-Ing. Wilfried Liebig**Organisation:** KIT Department of Mechanical Engineering**Part of:** Interdisciplinary Subject**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-MACH-105211	Materials of Lightweight Construction	4 CR	Liebig

Competence Certificate

Oral exam, about 25 minutes

Prerequisites

none

Competence Goal

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.

Content

Introduction

Constructive, production-oriented 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 and hardenable steels

Composites - mainly PMC
Matrices
Reinforcements

Workload

The workload for the lecture "Design with Plastics" is 120 h per semester and consists of the presence during the lectures (21 h), preparation and rework time at home (50 h) and preparation time for the oral exam (49 h).

M**6.126 Module: Measurement Technology [M-ETIT-105982]**

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [General Mechatronics](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-ETIT-112147	Measurement Technology	5 CR	Heizmann

Competence Certificate

The examination takes place in form of a written examination lasting 120 minutes.

Prerequisites

M-ETIT-102652 - Messtechnik (German version) must not have started.

Competence Goal

- Students have a sound knowledge of the theoretical foundations of measurement technology, including modeling of measurement systems, consideration of nonlinearities, stochastic deviations and stochastic signals, acquisition of analog signals, and frequency and rotational speed measurement.
- Students are proficient in the approaches to measurement system design in terms of model assumptions, methods, and achievable results.
- Students are able to analyze and formally describe measurement technology tasks, synthesize possible solutions for measurement systems and assess the properties of the solution obtained.

Content

The module deals with the formal, methodical and mathematical fundamentals for the analysis and design of measurement systems. Focal points of the course are

- Measurement systems and deviations (including scales, the SI systems, modeling of measurement systems)
- Curve fitting (approximation, interpolation)
- Stationary behavior of measurement systems (characteristic curve, errors of the characteristic curve, nonlinearities, adjustment)
- Stochastic measurement errors (probabilistic analysis, samples, statistical test methods, statistic process control, error propagation)
- Stochastic processes (correlational measurements, spectral description of stochastic signals, system identification, matched filter, Wiener filter)
- Digitization of analog signals (sampling, quantization, analog-digital converters, digital-analog converters)
- Frequency and rotational speed measurement (generalized frequency concept, digital speed measurement, detection of direction)

Module grade calculation

The module grade is the grade of the written examination.

Annotation

In the module a lecture, an exercise and an examination are offered.

Workload

The workload includes:

1. attendance in lectures and exercises: 34 h
2. preparation / follow-up of lectures and exercises: 51 h
3. preparation of and attendance in examination: 65 h

total: 150 h = 5 CR

Recommendation

Basic knowledge in the fields of "Probability Theory" as well as "Signals and Systems" is helpful.

M**6.127 Module: Mechanics in Microtechnology [M-MACH-102713]**

Responsible: Prof. Dr. Christian Greiner
Dr. Patric Gruber

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-105334	Mechanics in Microtechnology	4 CR	Greiner, Gruber

Competence Certificate

oral exam ca. 30 minutes

Prerequisites

none

Competence Goal

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.

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 Mechanical Parameters such as Young's Modulus and Yield Strength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Electrostatics,...
8. Aktuation: Inverse Piezo-electric Effect, Shape Memory, Elektromagnetic Actuation,...

Workload

regular attendance: 22,5 hours

self-study: 97,5 hours

Learning type

lecture

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. Wierink: „Mechanical Microsensors“ Springer Verlag 2000
5. Chang Liu: Foundations of MEMS, Illinois ECE Series, 2006

M**6.128 Module: Mechano-Informatics and Robotics [M-INFO-100757]**

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [Interdisciplinary Subject](#)

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

Mandatory			
T-INFO-101294	Mechano-Informatics and Robotics	4 CR	Asfour

Competence Goal

Students understand the basics of the synergistic integration of methods from mechatronics, computer science and artificial intelligence using the example of humanoid robotics. They are acquainted with the basic concepts and methods of machine learning, the description of robot movements and actions as well as artificial neural networks and their application in robotics.

In particular, they are able to apply basic methods to problems and know relevant tools. Using research-oriented examples from humanoid robotics, students have learned – in an interactive way – to think analytically and to proceed in a structured and goal-oriented way when analyzing, formalizing and solving tasks.

Content

The lecture addresses topics at the interface between robotics and artificial intelligence, which are illustrated and explained based on examples from current research in the area of humanoid robotics. The lecture introduces fundamental algorithms in robotics and machine learning as well as methods for describing dynamical systems and representing robot motions and actions. This includes an introduction to artificial neural networks, the description of dynamical systems in state space as well as the learning of movement primitives. The topics and content are illustrated by practical examples from humanoid robotics.

Recommendation

Der Besuch des *Basispraktikums Mobile Roboter* wird empfohlen.



6.129 Module: Medical Imaging Techniques I [M-ETIT-100384]

Responsible: Prof. Dr. Maria Francesca Spadea

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Medical Technology \(mandatory\)](#)
Interdisciplinary Subject

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

Mandatory			
T-ETIT-101930	Medical Imaging Techniques I	3 CR	Spadea

Competence Certificate

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

Prerequisites

none

Competence Goal

Students have a thorough understanding of all methods of medical imaging with ionizing radiation. They know the physical basics, the technical solutions and the essential aspects when using imaging in medicine.

Content

- X-ray physics and technology of X-ray imaging
- Digital radiography, X-ray image intensifier, flat X-ray detectors
- Theory of imaging systems, modulation transfer function
- and quantum detection efficiency
- Computer tomography CT
- Ionizing radiation, dosimetry and radiation protection
- SPECT and PET

Module grade calculation

The module grade is the grade of the written exam.

Workload

Each credit point corresponds to approximately 30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

Attendance time in lectures (2 h 15 appointments each) = 30 h

Self-study (3 h 15 appointments each) = 45 h

Preparation / post-processing = 20 h

Total effort approx. 95 hours = 3 LP

M**6.130 Module: Medical Imaging Techniques II [M-ETIT-100385]****Responsible:** Prof. Dr. Maria Francesca Spadea**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-101931	Medical Imaging Techniques II	3 CR	Spadea

Competence Certificate

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

Prerequisites

none

Competence Goal

Students have a thorough understanding of all methods of medical imaging without ionizing radiation. They know the physical basics, the technical solutions and the essential aspects when using imaging in medicine.

Content

- Ultrasound imaging
- Thermography
- Optical tomography
- Impedance tomography
- Imaging of bioelectric sources
- Endoscopy
- Magnetic resonance imaging
- Multi-modal imaging
- Molecular imaging

Module grade calculation

The module grade is the grade of the written exam.

Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

Attendance time in lectures (2 h 15 appointments each) = 30 h

Self-study (3 h 15 appointments each) = 45 h

Preparation / post-processing = 20 h

Total effort approx. 95 hours = 3 LP

Recommendation

The contents of the M-ETIT-100384 module are required.

M**6.131 Module: Methods of Signal Processing [M-ETIT-100540]**

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100694	Methods of Signal Processing	6 CR	Heizmann

Prerequisites
 none



6.132 Module: Micro System Simulation [M-MACH-105486]

Responsible: Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-108383	Microsystem Simulation	4 CR	Korvink

Competence Certificate

Oral exam (20 min)

Prerequisites

There are no requirements for background, however, I recommend that you have at least the following: Basic knowledge in engineering, physics, and mathematics.

Competence Goal

Students are able to formulate the finite element method such as needed for mechanics, heat transfer, or transport processes. They are familiar with approximation using functions, and the relation between a finite element CAD model, and the underlying mechanism to solve the equations, an essential basis for modern engineering design.

Content

Microsystems are multiphysical devices. For example, in order to measure infrared radiation, a microsystem might use the Seebeck (thermoelectric) effect, which couples heat to electrical currents – thus radiation, heat flow, and charge transport are coupled in a multiphysical manner.

Because microsystem components are very small (in the micrometre range), often the operational modalities will be described better by statistical mechanics or even quantum mechanics, so that we have to take caution to use the right models.

In many cases, commercial tools are unavailable, so that engineers are forced to build their own simulation programs to be able to make intelligent designs.

In this lecture you will learn the fundamentals needed to build such a computer program. Because we want to be very efficient in learning, and not re-invent all the wheels or confront computer science issues such as compilation and libraries, you will learn to build your program in the higher level programming environment Mathematica[®].

Annotation

The lecture is aimed at students who wish to learn the basis of numerical modelling and simulation programs, so as to understand the functioning of these most important engineering design tools. Practical examples are taken from microsystems engineering to illustrate the concepts.

Workload

Literature: 20 h

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Recommendation

Regular attendance is definitely recommended, as well as doing all the exercises.

Literature

The following references are used by the lecturers to prepare the lecture. Students are not required to access most of these, but of course it does not hurt! Hints for efficient further reading, depending on interest, will be provided during the lecture.

- E. Buckingham, On physically similar systems: illustrations on the use of dimensional equations, *Phys. Rev.* 4, 345–376 (1914)
- E. Buckingham, Model Experiments and the Forms of Empirical Equations, *ASME* 263–296 (1915)
- K. Eriksson, D. Estep, P. Hansbo, C. Johnson, *Computational Differential Equations*, Cambridge University Press, Cambridge (1996)
- Bengt Fornberg, Calculation of Weights in Finite Difference Formulas, *SIAM Rev.* 40(3) 1998
- Gene H. Golub, Charles F. van Loan, *Matrix Computations*, John Hopkins University Press 1996
- H. Hanche-Olsen, Buckingham's pi-theorem, Internet (2004)
- Arieh Iserles, *A First Course in the Numerical Analysis of Differential Equations*, Cambridge University Press, Cambridge (1996)
- Mathematica Help Documentation
- N. Metropolis, A.W. Rosenbluth, M.N. Rosenbluth, A.H. Teller and E. Teller, "Equation of State Calculations by Fast Computing Machines, *J. Chem. Phys.* 21 (1953) 1087-1092.
- Rick Beatson and Leslie Greengard, *A short course on fast multipole methods*



6.133 Module: Microactuators [M-MACH-100487]

Responsible: Prof. Dr. Manfred Kohl

Organisation: KIT Department of Mechanical Engineering

Part of: Field of Specialization / Field of Specialization: Microsystems Technology (mandatory)
Field of Specialization / Field of Specialization: Robotics (Complementary Modules)
Interdisciplinary Subject
Additional Examinations

Credits
4

Grading scale
Grade to a tenth

Recurrence
Each summer term

Duration
1 term

Language
German

Level
4

Version
1

Mandatory			
T-MACH-101910	Microactuators	4 CR	Kohl

Competence Certificate

Written exam: 60 min

Prerequisites

none

Competence Goal

- Knowledge of the actuation principles including pros and cons
- Knowledge of important fabrication technologies
- Explanation of layout and function of the microactuators
- Calculation of important properties (time constants, forces, displacements, etc.)
- Development of a layout based on specifications

Content

- Basic knowledge in the material science of the actuation principles
- Layout and design optimization
- Fabrication technologies
- Selected developments
- Applications

The lecture includes amongst others the following topics:

- Microelectromechanical systems: linear actuators, microrelais, micromotors
- Medical technology and life sciences: Microvalves, micropumps, microfluidic systems
- Microrobotics: Microgrippers, polymer actuators (smart muscle)
- Information technology: Optical switches, mirror systems, read/write heads

Workload

Time of attendance: 15 * 1,5 h = 22,5 h

Preparation and follow up: 15 * 5,5 h = 82,5 h

Exam Preparation and Exam: 15 h

Total: 120 h = 4 LP

Literature

- Lecture notes
- D. Jendritza, Technischer Einsatz Neuer Aktoren: Grundlagen, Werkstoffe, Designregeln und Anwendungsbeispiele, Expert-Verlag, 3. Auflage, 2008
- M. Kohl, Shape Memory Microactuators, M. Kohl, Springer-Verlag Berlin, 2004
- N.T.R. Nguyen, S.T. Wereley, Fundamentals and applications of Microfluidics, Artech House, Inc. 2002
- H. Zappe, Fundamentals of Micro-Optics, Cambridge University Press 2010



6.134 Module: Microenergy Technologies [M-MACH-102714]

Responsible: Prof. Dr. Manfred Kohl

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105557	Microenergy Technologies	4 CR	Kohl

Competence Certificate

Oral exam: 45 min

Prerequisites

none

Competence Goal

- Knowledge of the principles of energy conversion
- Knowledge of the underlying concepts of thermodynamics and materials science
- Explanation of layout, fabrication and function of the treated devices
- Calculation of important properties (time constants, forces, displacements, power, degree of efficiency, etc.)
- Development of a layout based on specifications

Content

- Basic physical principles of energy conversion
- Layout and design optimization
- Technologies
- Selected devices
- Applications

The lecture includes amongst others the following topics:

Micro energy harvesting of vibrations

Thermal micro energy harvesting

Microtechnical applications of energy harvesting

Heat pumps in micro technology

Micro cooling

Workload

Time of attendance: 15 * 1,5 h = 22,5 h

Preparation and follow up: 15 * 5,5 h = 82,5 h

Exam Preparation and Exam: 15 h

Total: 120 h = 4 LP

Literature

- Lecture notes (overhead transparencies) „Micro Energy Technologies“
- Stephen Beeby, Neil White, Energy Harvesting for Autonomous Systems, Artech House, 2010
- Shashank Priya, Daniel J. Inman, Energy Harvesting Technologies, Springer, 2009

M**6.135 Module: Microsystem Technology [M-ETIT-100454]****Responsible:** Prof. Dr. Wilhelm Stork**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100752	Microsystem Technology	3 CR	Stork

Competence Certificate

Achievement will be examined in an oral examination (approx. 20 minutes).

Prerequisites

none



6.136 Module: Microwave Engineering [M-ETIT-100535]

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-100802	Microwave Engineering	5 CR	Zwick

Competence Certificate

Success control is carried out as part of a written overall examination (120 minutes) of the selected courses, which in total meet the minimum requirement for LP.

Prerequisites

none

Competence Goal

The students have a deep understanding of microwave technology with a focus on passive components of microwave circuit technology. This includes the functioning of the most important microwave components such as waveguides, filters, resonators, couplers, power dividers up to directional lines and circulators. Students are able to understand and describe how these components work. You can transfer this knowledge to other areas of high-frequency technology and use it to analyze and solve high-frequency problems. You are able to apply what you have learned in a practical way.

Content

In-depth lecture on high-frequency technology: The focus of the lecture is the teaching of the functioning of the most important passive microwave components, starting with waveguides, through filters, resonators, power dividers and couplers to directional lines and circulators.

Accompanying the lecture, exercises are given on the lecture material. These are discussed in a large hall exercise and the associated solutions are presented in detail.

Module grade calculation

The module grade is the grade of the written exam.

Annotation

WS: German

SS: English

The exam is in each semester and for every student bilingual.

Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes: Attendance study time lecture / exercise: 45 h Self-study time including exam preparation: 105 h A total of 150 h = 5 LP

Recommendation

Knowledge of the basics of high frequency technology is helpful.

M**6.137 Module: Microwave Engineering Lab [M-ETIT-105300]**

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-110789	Microwave Engineering Lab	6 CR	Zwick

Competence Certificate

To prepare the laboratory tests, each laboratory group has to do some homework together before the experiment and hand in a simple copy to the supervisor immediately before the start of the experiment. The tasks for the experiment as such are processed and logged during the implementation. The protocol should be handed over to the supervisor immediately after the experiment has been carried out. Before each experiment, there is a written exam or oral (approx. 20 min., No aids) the content of the experiment.

Prerequisites

none

Competence Goal

The students have in-depth knowledge of high-frequency components and systems as well as how the most important high-frequency measuring devices work (network analyzer, spectrum analyzer, noise measurement, power measurement, oscilloscope, antenna measurement). They are also familiar with handling high-frequency measuring devices and components. They are able to independently select and operate measuring devices based on the specific applications and to interpret the measurement results. In addition, they are able to work together in a team in a self-organized manner.

Content

Under the motto: "Practical relevance through state-of-the-art equipment and current problems", the students are offered a modern and technically sophisticated high-frequency laboratory at master's level. The aim of the experiments is to deepen the theory imparted in the lectures in practice and to train the use of high-frequency measuring devices and RF components. In groups of 2-4 students, various experiments are carried out and recorded on 8 afternoons. The order and topics of the experiments can vary.

Module grade calculation

The grade for the test execution consists of the preparation, the protocol and the written or oral learning objective control for the respective test. The final grade for the entire laboratory results from the overall impression of the performance. Students who appear unprepared for the respective experiment are not allowed to take part in the experiment. The attempt must be repeated at another time.

Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes: Attendance study time laboratory: 45 h Test preparation, protocols, test preparation: 135 h A total of 180 h = 6 LP

Recommendation

Knowledge of microwave measurement technology and RF components and systems is helpful.



6.138 Module: Microwaves Measurement Techniques [M-ETIT-100424]

Responsible: Prof. Dr.-Ing. Thomas Zwick

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-100733	Microwaves Measurement Techniques	4 CR	Zwick

Competence Certificate

The success control is carried out as part of an oral overall examination (approx. 20 minutes) of the selected courses, which in total meet the minimum requirement for LP.

Prerequisites

none

Competence Goal

The students have an in-depth knowledge of the structure and functioning of microwave measuring devices (signal generator, power measurement, frequency measurement, spectral analyzer, network analyzer). They understand the special features of measuring powers, frequencies and scattering parameters in the microwave range. You can apply the knowledge you have learned in practice and interpret the measurement results. You can analyze and assess possible sources of error in the measurement. You are able to design measurement setups with given measurement values and to carry out the measurements correctly.

Content

This lecture contains all basic areas of today's high-frequency measurement techniques, such as power measurement, frequency measurement, spectral analysis and network analysis. Particular attention is paid to the description of those measurement systems and methods that are used in modern applications.

Module grade calculation

The module grade is the grade of the oral exam.

Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

Attendance study time lecture / exercise: 45 h

Self-study time including exam preparation: 75 h

A total of 120 h = 4 LP

Recommendation

Knowledge of the basics of high frequency technology is helpful.

M**6.139 Module: Modern Control Concepts I [M-MACH-105308]**

Responsible: apl. Prof. Dr. Lutz Groell
apl. Prof. Dr. Jörg Matthes

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105539	Modern Control Concepts I	4 CR	Groell, Matthes

Competence Certificate

A performance assessment is held in form of a written examination of 60 minutes.

Prerequisites

None

Competence Goal

After attending the lecture, the students are able to

- Analyze linear systems with respect to various properties,
- Identify linear dynamic models,
- Design linear controllers with feedforward control in the time domain and incooperate actuator limits,
- Use Matlab for the realization of the considered concepts and
- Implement controllers in software.

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. Concept 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)

Workload

1. Attendance time Lecture: $15 \cdot 1.5\text{h} = 22.5\text{h}$
2. Pre- and postprocessing time Lecture: $15 \cdot 3.5\text{h} = 52.5\text{h}$
3. Exam preparation and attendance exam: 45h

Total: 120h = 4 LP

Recommendation

The attendance of the following lecture is recommended:

- Grundlagen der Mess- und Regelungstechnik

Alternativly: comparable lectures at „Fakultät für Elektrotechnik und Informationstechnik“

Learning type

Lecture

M**6.140 Module: Modern Control Concepts II [M-MACH-105313]****Responsible:** apl. Prof. Dr. Lutz Groell**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-106691	Modern Control Concepts II	4 CR	Groell

Competence Certificate

A performance assessment is held in form of an oral examination of 30 minutes.

Prerequisites

None

Competence Goal

After attending the lectures, the students are able to

- analyze and control multivariable systems,
- analyze and control DAE systems,
- analyze and control time delay systems,
- use Matlab for simulation, analysis and synthesis of the discussed concepts,
- solve linear control problems with more routine.

Content

1. Discrete time systems
2. The role of zeros (different kinds of zeros, zero dynamics, internal model principle, repetitive control, 2Dof structures, controller design via Diophantine equations)
3. Limitations of control systems (existency question, limitations w.r.t. time and frequency domain)
4. Linear multivariable systems (state space with structural invariants, canonical forms in frequency domain, polynomial matrices, matrix fractions)
5. Multivariable control for LTI systems (coprime factorization, relative gain array analysis, decentral and cooperative controls, decoupling controls, tracking controls)
6. Internal model control (internal stability, Youla parametrization, predictive structures, different 2Dof structures)
7. Advanced control loop structures (serial and parallel cascades, multiple controller structures, inferential control, split range control, extremal controls)
8. Differential-algebraic systems of equations
9. Time delay systems
10. Open topic (based on learning progress and interests, the aforementioned topics are deepened or other topics, such as time-varying systems, model order reduction, alternative stability concepts, etc. are discussed.)

Workload

1. Attendance time Lecture: $15 \cdot 1.5\text{h} = 22.5\text{h}$
2. Pre- and postprocessing time Lecture: $15 \cdot 3.5\text{h} = 52.5\text{h}$
3. Exam preparation and attendance exam: 45h

Total: 120h = 4 LP

Recommendation

The attendance of the following lecture is recommended:

- Grundlagen der Mess- und Regelungstechnik
- Moderne Regelungskonzepte I

Alternativ: comparable lectures at „Fakultät für Elektrotechnik und Informationstechnik“

Learning type

Lecture

Literature

- Åström, K.-J., Murray, R.M.: Feedback Systems, 2012
- Skogestad, S., Postlethwaite, I.: Multivariable Feedback Control, 2001

M**6.141 Module: Modern Control Concepts III [M-MACH-105314]****Responsible:** apl. Prof. Dr. Lutz Groell**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-106692	Modern Control Concepts III	4 CR	Groell

Competence Certificate

A performance assessment is held in form of an oral examination of 30 minutes.

Prerequisites

None

Competence Goal

After attending the lectures, the students are able to

- analyze nonlinear systems and their solutions w.r.t. stability,
- design nonlinear controls with feedforward using different methods.

Content

1. Qualitative theory of ODEs (advanced solution term in ODEs, bifurcation, Poincaré index, equilibria in infinity)
2. Lyapunov stability (definitions, theorems, topological properties of domains of attraction, Barbashin-Krasovskii-LaSalle's theorem, Barbalat's lemma)
3. Feedback linearization
4. Modifications of feedback linearization (zero dynamics, advanced linearization)
5. Flatness-based controller design
6. Lyapunov-based controller design (backstepping design, nonlinear damping, tracking control)
7. Passivity-based controller design
8. Sliding mode control
9. Alternative linearization concepts
10. Open topic (based on learning progress and interests, the aforementioned topics are deepened or other topics, such as alternative stability concepts, observer design for nonlinear systems, basics in differential geometry, analysis and synthesis of underactuated systems, hybrid systems, Luré-type control or adaptive control.)

Workload

1. Attendance time Lecture: $15 \cdot 1.5h = 22.5h$
2. Pre- and postprocessing time Lecture: $15 \cdot 3.5h = 52.5h$
3. Exam preparation and attendance exam: 45h

Total: 120h = 4 LP

Recommendation

The attendance of the following lecture is recommended:

- Grundlagen der Mess- und Regelungstechnik
- Moderne Regelungskonzepte I und II

Alternativly: comparable lectures at „Fakultät für Elektrotechnik und Informationstechnik“

Learning type

Lecture

Literature

- Khalil, H.: Nonlinear Systems, 1991.
- Krstic, M.; Kanellakopoulos, I.; Kokotovic, P.: Nonlinear and Adaptive Control Design, 1995.

M**6.142 Module: Modern Radio Systems Engineering [M-ETIT-100427]****Responsible:** Prof. Dr.-Ing. Thomas Zwick**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject****Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
English**Level**
4**Version**
1**Mandatory**

T-ETIT-100735

Modern Radio Systems Engineering

4 CR

Zwick

Competence Certificate

The success control is carried out as part of an oral overall examination (approx. 20 minutes) of the selected courses, which in total meet the minimum requirement for LP.

Prerequisites

none

Competence Goal

After attending this course, students will be able to design an analog front end for a radio transmission system at the block diagram level. In particular, the non-idealities of typical components of high-frequency technology and their effects on the overall system performance are part of the knowledge imparted. The students also have an in-depth understanding of various radar modulation methods and the relationships to approval conditions and performance.

Content

The course gives a general overview of radio transmission systems and their components. The focus is on the system components realized in analog technology and their non-idealities. Based on the physical functioning of the various system components, parameters are derived that allow an examination of their influence on the overall system performance.

The exercise is closely linked to the lecture and mainly consists of computer-based exercises that allow a visualization of the influences of various non-idealities on the overall system performance and demonstrate the practical system design of modern radio transmission systems.

Module grade calculation

The module grade is the grade of the oral exam.

Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

Attendance study time lecture: 30 h

Attendance study time computer exercise SystemVue ESL Design Software / MATLAB: 15 h

Self-study time including exam preparation: 75 h

A total of 120 h = 4 LP

Recommendation

Knowledge of the basics of radio frequency technology and communications technology is helpful.

M**6.143 Module: Motion in Human and Machine - Seminar [M-INFO-102555]****Responsible:** Prof. Dr.-Ing. Tamim Asfour**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German/English**Level**
4**Version**
2

Mandatory			
T-INFO-105140	Motion in Human and Machine - Seminar	3 CR	Asfour

Competence Goal

The student knows procedures for modelling human motion, as well as possibilities for its processing and analysis. He/she knows methods for learning motion primitives and mapping human motion to robots that have different kinematics and dynamics and can apply them in new contexts.

Content

This interdisciplinary block seminar deals with methods of modelling, generating and controlling movements in humans and robot systems. Students get an insight into this interdisciplinary field and learn the basics of biological motion, biomechanical simulation, robotics, and machine learning. In the introduction, motion generation as effect of muscle contraction is discussed. It will be shown how movement patterns can be identified and categorized based on the observation of human movements and how these patterns can be reproduced on a humanoid robot. Finally, methods for the learning of movement primitives from human demonstration will be presented and their application for the generation of motion for humanoid robots will be explained.

Annotation

The block practical course is an interdisciplinary event in cooperation with the University of Stuttgart, University of Tübingen and the Hertie Institute for Clinical Brain Research; Centre for Integrative Neuroscience in Tübingen.

Workload

Seminar with 3 SWS, 3 LP
 3 LP corresponds to 90 hours, including
 30 hours attendance time
 15 hours group work
 20 hours literature research
 20 hours manuscript preparation
 5 hours video creation

Recommendation

Programming experience in C++, Python or Matlab is recommended.

Attending the lectures Robotics I – Introduction to Robotics, Robotics II: Humanoid Robotics, Robotics III - Sensors and Perception in Robotics, Mechano-Informatics and Robotics and Wearable Robotic Technologies is recommended.



6.144 Module: Motor Vehicle Laboratory [M-MACH-102695]

Responsible: Dr.-Ing. Michael Frey

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-105222	Motor Vehicle Labor	4 CR	Frey

Competence Certificate

After completion of the experiments: written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites

None

Competence Goal

The students have deepened their knowledge on motor vehicles acquired in lectures and can apply it practically. They have an overview of the applied measuring technique and can execute and analyse measurements for the handling of given problem definitions. They are ready to analyze and to judge measurement results.

Content

1. Determination of the driving resistances of a passenger vehicle on a roller dynamometer; measurement of the engine performance of the test vehicle
2. Investigation of a twin-tube and a single-tube shock absorber
3. Behavior of car tyres under longitudinal forces and lateral forces
4. Behavior of car tires on wet road surface
5. Rolling resistance, energy dissipation and high-speed strength of car tires
6. Investigation of the moment transient characteristic of a Visco clutch

Annotation

The admission is limited to 12 persons per group.

Workload

regular attendance: 31,5 hours

self-study: 103,5 hours

Literature

1. Matschinsky, W: Radführungen der Straßenfahrzeuge, Verlag TÜV Rheinland, 1998
2. Reimpell, J.: Fahrwerktechnik: Fahrzeugmechanik, Vogel Verlag, 1992
3. Gnadler, R.: Documents to the Motor Vehicle Laboratory

M**6.145 Module: Nano- and Quantum Electronics [M-ETIT-105604]****Responsible:** Prof. Dr. Sebastian Kempf**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject****Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
English**Level**
4**Version**
1

Mandatory			
T-ETIT-111232	Nano- and Quantum Electronics	6 CR	Kempf

Competence Certificate

The assessment of success takes place in the form of a written examination lasting 120min. The grade corresponds to the result of the written examination.

Prerequisites

none

Competence Goal

Students will understand the physical limits of CMOS scaling and will be able to analyze the function of conventional nanoelectronic devices. Students will also understand the operation of novel nanoelectronic and quantum electronic devices and will be able to design this kind of devices that are based on quantum mechanical effects. They develop the ability to design nanoelectronic sensors and devices and can understand and analyze the fabrication methods for nano- and quantum electronic devices.

Content

Nanoelectronics deals with integrated circuits whose typical length scale is well below 100nm. In this regime, physical effects, in particular of quantum mechanical origin, occur and strongly influence the scaling of classical microelectronic devices. This ultimately leads to a new form of electronic components as well as novel operation principles. A special form of nanoelectronics is quantum electronics in which quantum mechanical effects are exploited on purpose to build an entirely new class of devices whose performance reaches far beyond any other microelectronics devices. Well-known examples are superconducting digital electronics which enables to build, for example, microprocessors with clock rates exceeding several 100GHz, or the quantum computer, which will lead to a change of paradigms in the field of information processing.

Within this context, the module "Nano- and quantum electronics" intends to give students an overview of the theoretical and practical aspects of nano- and quantum electronics. In particular, it discusses the following topics:

- Limitations of conventional CMOS technology
- Quantum mechanical effects in the field of nano- and quantum electronics (quantized conductance, Coulomb blockade, tunnel effect, etc.)
- Hot-electron effect
- Nano- and quantum-technological manufacturing and analysis methods
- Nanostructure field-effect transistors
- Quantum dots
- Carbon nanotube field-effect transistor
- Resonant tunnel diodes
- Unipolar resonant tunnel transistor
- Single Electron Transistor (SET)
- Josephson junction based analog and digital electronics
- Quantum bits, quantum computers and quantum computing

The tutorial is closely linked to the lecture and deals with special aspects concerning the development of nano- and quantum electronics. In particular, the development and system integration of such devices for various applications is discussed by means of exercises.

Module grade calculation

The module grade is the grade of the written examination.

Workload

A workload of approx. 175h is required for the successful completion of the module. This is composed as follows:

- Attendance time in lectures and exercises: $18 \cdot 1.5h + 6 \cdot 1.5h = 36h$
- Preparation and follow-up of lectures: $21 \cdot 3h = 54h$
- Preparation and follow-up of tutorials: $7 \cdot 5h = 35h$
- Preparation for the exam: 50h

Recommendation

Successful completion of the modules "Superconductivity for Engineers" and „Einführung in die Quantentheorie für Elektrotechniker“ is recommended.

M**6.146 Module: Nonlinear Control Systems [M-ETIT-100371]****Responsible:** Prof. Dr.-Ing. Sören Hohmann**Organisation:** KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
 Interdisciplinary Subject

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

Mandatory			
T-ETIT-100980	Nonlinear Control Systems	3 CR	Kluwe

Prerequisites

none

M**6.147 Module: Nonlinear Optics [M-ETIT-100430]**

Responsible: Prof. Dr.-Ing. Christian Koos
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: **Interdisciplinary Subject**

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	2

Mandatory			
T-ETIT-101906	Nonlinear Optics	6 CR	Koos

Competence Certificate

The oral exam is offered continuously upon individual appointment.

Prerequisites

none

Competence Goal

The students

- understand and can mathematically describe the effect of basic nonlinear-optical phenomena using optical susceptibility tensors,
- understand and can mathematically describe wave propagation in nonlinear anisotropic materials,
- have an overview and can quantitatively describe common second-order nonlinear effects comprising the electro-optic effect, second-harmonic generation, sum- and difference frequency generation, parametric amplification and optical rectification,
- have an overview and can quantitatively describe the Kerr effect and other common third-order nonlinear effects, comprising self- and cross-phase modulation, four-wave mixing, self-focussing, and third-harmonic generation,
- have an overview and can describe nonlinear-optical interaction in active devices such as semiconductor optical amplifiers
- conceive the basic principles of various phase-matching techniques and can apply them to practical design problems,
- conceive the basic principles electro-optic modulators, can apply them to practical design problems, and have an overview on state-of-the art devices,
- conceive the basic principles third-order nonlinear signal processing and can apply them to practical design problems.

Content

1. The nonlinear optical susceptibility: Maxwell's equations and constitutive relations, relation between electric field and polarization, formal definition and properties of the nonlinear optical susceptibility tensor,
2. Wave propagation in nonlinear anisotropic materials
3. Second-order nonlinear effects and devices: Linear electro-optic effect / Pockels effect, second-harmonic generation, sum- and difference-frequency generation, phase matching, parametric amplification, optical rectification
4. Third-order nonlinear effects and devices: Nonlinear refractive index and Kerr effect, self- and cross-phase modulation, four-wave mixing, self-focussing, third-harmonic generation
5. Nonlinear effects in active optical devices

Module grade calculation

The module grade is the grade of the oral exam.

There is a bonus system based on the problem sets that are solved during the tutorials: During the term, 3 problem sets will be collected in the tutorial and graded without prior announcement. If for each of these sets more than 70% of the problems have been solved correctly, a bonus of 0.3 grades will be granted on the final mark of the oral exam.

Workload

Approx. 180 h – 30 h lectures, 30 h exercises, 120 h homework and self-studies

Literature

R. Boyd. Nonlinear Optics. Academic Press, New York, 1992.

E.H. Li S. Chiang Y. Guo, C.K. Kao. Nonlinear Photonics. Springer Verlag, 2002

G. Agrawal, Nonlinear Fiber Optics, Academic Press, San Diego, 1995.

M**6.148 Module: Novel Actuators and Sensors [M-MACH-105292]****Responsible:** Prof. Dr. Manfred Kohl**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer

Competence Certificate

Written exam, 60 min

Prerequisites

None

Competence Goal

- Knowledge of the actuation and sensing principles including pros and cons
- Knowledge of important fabrication technologies
- Explanation of layout and function of the actuators and sensors
- Calculation of important properties (time constants, forces, displacements, sensitivity etc.)
- Development of a layout based on specifications

Content

The content of the lecture is among others:

- Piezo actuators
- Magnetostruktive actuators
- Shape memory actuators
- Electro-/Magnetorheological actuators
- Sensors: Concepts, materials, fabrication
- Micromechanical sensors: Pressure, force, inertial sensors
- Temperature sensors
- Sensors for bioanalytics
- Mechano-magnetic sensors

Workload

lecture time 18 h

self preparation: 102 h

Learning type

Lecture

Literature

- Vorlesungsskript "Neue Aktoren" und Folienskript "Sensoren"
- Micro Mechatronics, K. Uchino, 2nd ed., CRC Press, Taylor & Francis Group, 2019.
- 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



6.149 Module: Numerical Methods [M-MATH-105831]

Responsible: Prof. Dr. Wolfgang Reichel
Organisation: KIT Department of Mathematics
Part of: [General Mechatronics](#)

Credits
5

Grading scale
Grade to a tenth

Recurrence
Each summer term

Duration
1 term

Language
English

Level
4

Version
1

Mandatory			
T-MATH-111700	Numerical Methods - Exam	5 CR	Kunstmann, Plum, Reichel

Competence Certificate

Success control takes the form of a written examination (120 minutes).

Prerequisites

none

Competence Goal

Students who pass the module are familiar with basic concepts and ways of thinking on the topic of numerical mathematics. They know different procedures for solving linear and nonlinear problems in numerical mathematics. They are furthermore able to use numerical methods for solving problems from applications in an independent, critical, and needs-based way.

Content

In the lecture basic ideas and numerical methods for the following topics will be presented:

- systems of linear equations, Gauss-algorithm, LR-decomposition, Cholesky decomposition
- eigenvalue problems, von-Mises iteration
- linear optimization (also called linear programming)
- error analysis
- Newton's method
- quadrature, Newton-Cotes formulas
- numerical solution of initial value problems, Runge-Kutta methods
- finite difference method for solving boundary value problems
- finite elements

Module grade calculation

The module grade is the grade of the written exam.

Workload

Approximately 150h workload. The workload includes:

45h - attendance in lectures, exercises and examination

105h – self studies:

- follow-up and deepening of the course content
- solving problem sheets
- literature study and internet research on the course content
- preparation for the module examination

M**6.150 Module: Optical Communications Laboratory [M-ETIT-100437]**

Responsible: Prof. Dr.-Ing. Christian Koos
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [Interdisciplinary Subject](#)

Credits
6

Grading scale
Grade to a tenth

Recurrence
Each summer term

Duration
1 term

Language
German

Level
4

Version
1

Mandatory			
T-ETIT-100742	Optical Communications Laboratory	6 CR	Koos

Prerequisites
none

M**6.151 Module: Optical Design Lab [M-ETIT-100464]****Responsible:** Prof. Dr. Wilhelm Stork**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject****Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
English**Level**
4**Version**
2

Mandatory			
T-ETIT-100756	Optical Design Lab	6 CR	Stork

Competence Certificate

The examination consists of an oral exam (20 min).

Prerequisites

none

Competence Goal

The students can apply previous theoretical knowledge in optics to design optical systems based on ray tracing, using a typical optics design software.

The students can apply typical analysis methods to evaluate the imaging performance of optical systems.

The students can recognize aberrations in optical systems and apply methods to compensate them.

Content

The students participating in this lab are given the opportunity to gain practical experience in the use of software tools commonly used in industry for the design of optical elements and systems. Thus improving their knowledge in optical engineering.

Module grade calculation

The module grade is the grade of the oral exam.

Workload

Approximately 162 h workload of the student.

The workload includes:

- attendance in lectures and exercises: 36 h
- 9 exercises of 4 h
- preparation / follow-up: 51 h
- preparation 9x3 h
- writing lab reports: 8x3 h
- preparation of and attendance in examination: 75h

Recommendation

Basic knowledge in optics. The participation in the course Optical Engineering is strongly advised.

M**6.152 Module: Optical Transmitters and Receivers [M-ETIT-100436]****Responsible:** Prof. Dr. Wolfgang Freude**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject****Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
English**Level**
4**Version**
2**Mandatory**

T-ETIT-100639	Optical Transmitters and Receivers	6 CR	Freude
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Competence Certificate

Oral examination (approx. 20 minutes). The individual dates for the oral examination are offered regularly.

Prerequisites

none

Competence Goal

The students

- understand the peculiarities of optical communications, and how optical signals are generated, transmitted and received,
- know about sampling, quantization and coding,
- learn the basics about noise on reception,
- understand the properties of a linear and a nonlinear optical fibre channel, grasp the idea of channel capacity and spectral efficiency,
- know about various forms of modulation,
- acquire knowledge of optical transmitter elements,
- understand the function of optical amplifiers,
- have a basic understanding of optical receivers,
- know the sensitivity limits of optical systems, and
- understand how these limits are measured.

Content

The course concentrates on basic optical communication concepts and connects them with the properties of physical components. The following topics are discussed:

- Advantages and limitations of optical communication systems
- Optical transmitters comprising lasers and modulators
- Optical receivers comprising direct and heterodyne reception
- Characterization of signal quality

Module grade calculation

The module grade is the grade of the oral exam.

Workload

Approx. 120 hours workload for the student. The amount of work is included:

30 h - Attendance times in lectures

15 h - Exercises

75 h - Preparation / revision phase

Recommendation

Knowledge of the physics of the pn-junction

Literature

Detailed textbook-style lecture notes can be downloaded from the IPQ lecture pages.

Grau, G.; Freude, W.: Optische Nachrichtentechnik, 3. Ed. Berlin: Springer-Verlag 1991. In German. Since 1997 out of print. Electronic version available via w.freude@kit.edu.

Kaminow, I. P.; Li, Tingye; Willner, A. E. (Eds.): Optical Fiber Telecommunications VI A: Components and Subsystems +VI B: Systems and Networks', 6th Ed. Elsevier (Imprint: Academic Press), Amsterdam 2013

M**6.153 Module: Optical Waveguides and Fibers [M-ETIT-100506]****Responsible:** Prof. Dr.-Ing. Christian Koos**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-101945	Optical Waveguides and Fibers	4 CR	Koos

Competence Certificate

Type of Examination: Oral exam

Duration of Examination: approx. 20 minutes

Modality of Exam: The written exam is offered continuously upon individual appointment.

Prerequisites

None

Competence Goal

The students

- conceive the basic principles of light-matter-interaction and wave propagation in dielectric media and can explain the origin and the implications of the Lorentz model and of Kramers-Kronig relation,
- are able to quantitatively analyze the dispersive properties of optical media using Sellmeier relations and scientific databases,
- can explain and mathematically describe the working principle of an optical slab waveguide and the formation of guided modes,
- are able to program a mode solver for a slab waveguide in Matlab,
- are familiar with the basic principle of surface plasmon polariton propagation,
- know basic structures of planar integrated waveguides and are able to model special cases with semi-analytical approximations such as the Marcatali method or the effective-index method,
- are familiar with the basic concepts of numerical mode solvers and the associated limitations,
- are familiar with state-of-the-art waveguide technologies in integrated optics and the associated fabrication methods,
- know basic concepts of step-index fibers, graded-index fibers and microstructured fibers,
- are able to derive and solve basic relations for step-index fibers from Maxwell's equations,
- are familiar with the concept of hybrid and linearly polarized fiber modes,
- can mathematically describe signal propagation in single-mode fibers design dispersion-compensated transmission links,
- conceive the physical origin of fiber attenuation effects,
- are familiar with state-of-the-art fiber technologies and the associated fabrication methods,
- can derive models for dielectric waveguide structures using the mode expansion method,
- conceive the principles of directional couplers, multi-mode interference couplers, and waveguide gratings,
- can mathematically describe active waveguides and waveguide bends.

Content

1. Introduction: Optical communications
2. Fundamentals of wave propagation in optics: Maxwell's equations in optical media, wave equation and plane waves, material dispersion, Kramers-Kroig relation and Sellmeier equations, Lorentz and Drude model of refractive index, signal propagation in dispersive media.
3. Slab waveguides: Reflection from a plane dielectric boundary, slab waveguide eigenmodes, radiation modes, inter- and intramodal dispersion, metal-dielectric structures and surface plasmon polariton propagation.
4. Planar integrated waveguides: Basic structures of integrated optical waveguides, guided modes of rectangular waveguides (Marcatili method and effective-index method), basics of numerical methods for mode calculations (finite difference- and finite-element methods), waveguide technologies in integrated optics and associated fabrication methods
5. Optical fibers: Optical fiber basics, step-index fibers (hybrid modes and LP-modes), graded-index fibers (infinitely extended parabolic profile), microstructured fibers and photonic-crystal fibers, fiber technologies and fabrication methods, signal propagation in single-mode fibers, fiber attenuation, dispersion and dispersion compensation
6. Waveguide-based devices: Modeling of dielectric waveguide structures using mode expansion and orthogonality relations, multimode interference couplers and directional couplers, waveguide gratings, material gain and absorption in optical waveguides, bent waveguides

Module grade calculation

The module grade is the grade of the oral exam.

There is, however, a bonus system based on the problem sets that are solved during the tutorials: During the term, 3 problem sets will be collected in the tutorial and graded without prior announcement. If for each of these sets more than 70% of the problems have been solved correctly, a bonus of 0.3 grades will be granted on the final mark of the oral exam.

Workload

Total 120 h, hereof 45 h contact hours (30 h lecture, 15 h tutorial) and 75 h homework and self-studies.

Recommendation

Solid mathematical and physical background, basic knowledge of electrodynamics

Literature

B.E.A. Saleh, M.C. Teich: Fundamentals of Photonics

G.P. Agrawal: Fiber-optic communication systems

C.-L. Chen: Foundations for guided-wave optics

Katsunari Okamoto: Fundamentals of Optical Waveguides

K. Iizuka: Elements of Photonics

M**6.154 Module: Optimal Control and Estimation [M-ETIT-102310]****Responsible:** Prof. Dr.-Ing. Sören Hohmann**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-104594	Optimal Control and Estimation	3 CR	Hohmann

Prerequisites

none

M**6.155 Module: Optimization of Dynamic Systems [M-ETIT-100531]****Responsible:** Prof. Dr.-Ing. Sören Hohmann**Organisation:** KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(mandatory\)](#)
[Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(mandatory\)](#)
[Field of Specialization / Field of Specialization: Robotics \(mandatory\)](#)
 Interdisciplinary Subject

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-ETIT-100685	Optimization of Dynamic Systems	5 CR	Hohmann

Competence Certificate

The assessment consists of a written exam (120 min) taking place in the recess period.

Prerequisites

none

Competence Goal

- The students know as well the mathematical basics as the fundamental methods and algorithms to solve constraint and unconstraint nonlinear static optimization problems.
- They can solve constraint and unconstraint dynamic optimization by using the calculus of variations approach and the Dynamic Programming method.
- Also they are able to transfer dynamic optimization problem to static problems.
- The students know the mathematic relations, the pros and cons and the limits of the particular optimization methods.
- They can transfer problems from other fields of their studies in a convenient optimization problem formulation and they are able to select and implement suitable optimization algorithms for them by using common software tools.

Content

The module teaches the mathematical basics that are required to solve optimization problems. The first part of the lecture treats methods for solving static optimization problems. The second part of the lecture focuses on solving dynamic optimization problems by using the method of Euler-Lagrange and the Hamilton method as well as the dynamic programming approach.

Module grade calculation

The module grade is the grade of the written exam.

Workload

Each credit point stands for an amount of work of 30h of the student. The amount of work includes

1. presence in lecture/exercises/tutorial(optional) (2+1 SWS: 45h1.5 LP)
2. preparation/postprocessing of lecture/exercises (90h3 LP)
3. preparation/presence in the written exam (15h0.5 LP)

M**6.156 Module: Optoelectronic Measurement Engineering [M-ETIT-100484]****Responsible:** Dr.-Ing. Klaus Trampert**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-100771	Optoelectronic Measurement Engineering	3 CR	Trampert

Prerequisites

none

Module grade calculation

The module grade is the grade of the oral exam.

Workload

Based on 15 courses per semester, each with 1.5 h presence in the lecture, 2.5 h each Before and after, as well as approx. 2 hours of literature reading and self-exercises, the total workload is 90 hours

M**6.157 Module: Optoelectronics [M-ETIT-100480]****Responsible:** Prof. Dr. Ulrich Lemmer**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-100767	Optoelectronics	4 CR	Lemmer

Competence Certificate

The success check is carried out in the context of a written exam (90 minutes).

Prerequisites

none

Module grade calculation

The module grade is the grade of the written exam.

Workload

1. Presence time in lectures, exercises: 32 h
2. Preparation / Post-processing of the same: 48 h
3. Exam preparation and presence in same: 40 h

M**6.158 Module: Organ Support Systems [M-MACH-102702]****Responsible:** apl. Prof. Dr. Christian Pylatiuk**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Medical Technology \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105228	Organ Support Systems	4 CR	Pylatiuk

Competence Certificate

A performance assessment is held in form of a written examination of 45 minutes.

Prerequisites

none

Competence Goal

Students have comprehensive knowledge of the functioning of support systems and their components (e.g. sensors, actuators) for different human organs (e.g. heart, kidney, liver, eye, ear, locomotor system). They know the physical basics, the technical solutions and the essential aspects of these medical technology systems and their current limitations. Furthermore, they know bioreactors and other methods of using the body's own cells to support organs (tissue engineering). Furthermore, they have comprehensive knowledge of organ transplantation and its limitations.

Content

Hemodialysis, liver dialysis, heart-lung machine, artificial hearts, biomaterials, definition and classification of organ support and organ replacement, hearing prostheses, visual prostheses, exoskeletons, neuroprostheses, endoprostheses, tissue engineering.

Module grade calculation

The module grade is the grade of the written exam.

Workload

1. Attendance time Lecture: $15 \cdot 2h = 30h$
2. Pre- and postprocessing time Lecture: $15 \cdot 3h = 45h$
3. Exam preparation and attendance exam: 45h

Total: 120h = 4 LP

Recommendation

The content of module MMACH-105235 complements this lecture.

Literature

- Jürgen Werner: Kooperative und autonome Systeme der Medizintechnik: Funktionswiederherstellung und Organersatz. Oldenbourg Verlag.
- Rüdiger Kramme: Medizintechnik: Verfahren - Systeme – Informationsverarbeitung. Springer Verlag.
- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.

M**6.159 Module: Pattern Recognition [M-INFO-100825]**

Responsible: Prof. Dr.-Ing. Jürgen Beyerer
Organisation: KIT Department of Informatics
Part of: [Interdisciplinary Subject](#)

Credits
6

Grading scale
Grade to a tenth

Recurrence
Each summer term

Duration
1 term

Language
German

Level
4

Version
2

Mandatory			
T-INFO-101362	Pattern Recognition	6 CR	Beyerer, Zander

M**6.160 Module: Photovoltaics [M-ETIT-100513]****Responsible:** Prof. Dr.-Ing. Michael Powalla**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
2

Mandatory			
T-ETIT-101939	Photovoltaics	6 CR	Powalla

Prerequisites

Module "M-ETIT-100524 - Solar Energy" must not have started.

Modeled Conditions

The following conditions have to be fulfilled:

1. The module [M-ETIT-100524 - Solar Energy](#) must not have been started.

M**6.161 Module: Physical and Data-Based Modelling [M-ETIT-105468]****Responsible:** Prof. Dr.-Ing. Sören Hohmann**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
English**Level**
4**Version**
4

Mandatory			
T-ETIT-111013	Physical and Data-Based Modelling	6 CR	Hohmann

Competence Certificate

Oral examination of approximately 20 minutes.

Prerequisites

none

Competence Goal

- The students understand the general model concept as well as the characteristics of physical and data-based modeling and can describe their differences.
- They are able to structure complex systems and systematically analyze dependencies of subsystems.
- They are able to explain the general procedure of physical and data-based modeling, apply it to technical systems, and analyze the results.
- They are able to apply causal and non-causal modeling approaches and distinguish between them.
- Students have gained an understanding of generalized, cross-domain, physical relationships and can develop models for electrical, mechanical, pneumatic and hydraulic systems. They can identify states and constraints.
- They can describe the relationship between generalized, cross-domain, physical models and basic procedures of physical-based control and explain their advantages / limitations based on basic knowledge of control engineering.
- They are able to explain different identification procedures for parametric models of static and dynamic systems, select, and apply appropriate procedures for given technical problems.
- Students know basic procedures of learning-based identification and can describe their limitations.
- The students can estimate and judge the effects of disturbances and real conditions on the identification results.

Content

In contrast to the former “Modellbildung und Identifikation”, this course requires a profound knowledge in multivariable systems and optimization. Thus, attendance of the lecture [Optimization of Dynamic Systems \(ODS\)](#) is an absolute precondition to appropriately follow the course! Prior knowledge about (linear) state space representations and realizations, the concept of “zeros” in the state space, and observability is highly recommended!

This course aims at engineering students that focus on a systemic and control engineering curriculum. It encompasses fundamental topics along the complete process of modeling technical systems. Particularly, two major areas will be covered:

On the one hand, physical-based modeling techniques which derive formal model equations based on analyzing the physical first-principles of technical systems. This includes, inter alia, generalized equivalent circuits, bond graphs, port-Hamiltonian systems, variational analysis (Euler-Lagrange of the first kind). Selected topics of physical-based control methods will also be briefly introduced to integrate the complete physical control design in the wider control context and highlight its possible benefits.

On the other hand, data-based identification techniques will be covered which are used to identify concrete model parameters for a given technical system from experimental data sets. When combining the identification with an initial, non-physical, structural set up of model equations, the complete process is often referred to as data-based modeling or black-box modeling.

Module grade calculation

The module grade is the grade of the oral exam.

Workload

Each credit point corresponds to 30 hours of workload (of the student). The workload includes:

1. attendance time in lecture/exercise (3+1 SWS: 60h 2 LP)
2. pre-/postprocessing of the lecture (90h 3 LP)
3. preparation/attendance oral exam (30h 1 LP)

Recommendation

In contrast to the former “Modellbildung und Identifikation”, this course requires a profound knowledge in multivariable systems and optimization. Thus, attendance of the lecture [Optimization of Dynamic Systems \(ODS\)](#) is an absolute precondition to appropriately follow the course! Prior knowledge about (linear) state space representations and realizations, the concept of “zeros” in the state space, and observability is highly recommended (see e.g. [Regelung linearer Mehrgrößensysteme \(RLM\)](#))!

Furthermore, sound understanding of Higher Mathematics I-III, linear electrical network theory and engineering mechanics / physics is required to successfully attend the lecture, exercise tasks / case studies, and exam.

M**6.162 Module: Physiology and Anatomy for Biomedical Engineering [M-ETIT-105874]****Responsible:** Prof. Dr. Werner Nahm**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-111815	Physiology and Anatomy for Biomedical Engineering	6 CR	Nahm

Competence Certificate

The examination is carried out in the form of a written test of 120 minutes.

The examination includes the contents of Physiologie und Anatomie I (offered every winter term) and Physiologie und Anatomie II (offered every summer term).

Prerequisites

The modules "M-ETIT-100390 - Physiologie und Anatomie I" and "M-ETIT-100391 - Physiologie und Anatomie II" must not been started.

Content**Physiologie und Anatomie I (Wintersemester)**

The lecture provides basic knowledge about the essential organ systems of humans and medical terminology. It is aimed at students of technical courses who are interested in physiological issues.

Thematic blocks:

- Introduction - organizational levels in the body
- Basics of biochemistry in the body
- Cell structure, cell physiology, tissue
- Transport mechanisms in the body
- Neurophysiology I (nerve cell, muscle cell, the autonomic nervous system)
- Heart and circulatory system with blood and lymph
- Breathing

Physiologie und Anatomie II (Sommersemester)

The lecture extends the knowledge imparted in the first part of the lecture and introduces other human organ systems.

Thematic blocks:

- Acid / base balance, water balance, kidney function
- Thermoregulation
- Digestive system and nutrition
- Hormonal System Neurophysiology II
- (Organization of the CNS, somatosensory, motor skills, integrative performance of the brain)

Module grade calculation

The module grade is the grade of the written exam.

Annotation

This module is part of the Orientation Exam of SPO BSc Medizintechnik § 8. The examination must be taken by the end of the 2nd semester. A repeat examination must be taken by the end of the 3rd semester.

Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

- Attendance time in lectures (2 h, 30 appointments each) = 60 h
- Self-study (3 h, 30 appointments each) = 90 h
- Preparation / post-processing = 30 h

Total effort approx. 180 hours = 6 LP

Learning type**Winter/summer term:**

- WT: Physiologie und Anatomie I
- ST: Physiologie und Anatomie II

M**6.163 Module: Plasma Sources [M-ETIT-100481]****Responsible:** Dr.-Ing. Rainer Kling**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
1**Mandatory**

T-ETIT-100768	Plasma Sources	4 CR	Heering, Kling
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Prerequisites

none

M**6.164 Module: Plastic Electronics / Polymerelectronics [M-ETIT-100475]****Responsible:** Prof. Dr. Ulrich Lemmer**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-100763	Plastic Electronics / Polymerelectronics	3 CR	Lemmer

Competence Certificate

Type of Examination: oral exam (approx. 20 minutes)

Prerequisites

none

Competence Goal

The students

- understand the electronic and optical characteristics of organic semiconductors
- know the fundamental differences between organic and conventional inorganic semiconductors.
- have basic knowledge of manufacturing and processing technologies,
- have knowledge of organic light-emitting diodes, organic solar cells and photodiodes, organic field-effect transistors and organic lasers.
- have an overview of the possible applications, markets and development lines for these components.
- are able to work in multidisciplinary teams with engineers, chemists and physicists

Content

1. Introduction
2. Optoelectronic properties of organic semiconductors
3. Organic light emitting diodes (OLEDs)
4. Applications in Lighting and Displays
5. Organic FETs
6. Organic photodetectors and solar cells
7. Lasers and integrated optics

Module grade calculation

The module grade is the grade of the written exam.

Annotation

Lecture and excersises are held as required in German or English.

Workload

1. lecture: 21 h
2. recapitulation and self-studie: 42 h
3. preparation of examniation: 27 h

Recommendation

Knowledge of semiconductor components

LiteratureThe corresponding documents are available online in the VAB (<https://studium.kit.edu/>)

M**6.165 Module: Plug-and-Play Material Handling [M-MACH-104983]****Responsible:** Prof. Dr.-Ing. Kai Furmans**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Industrial Automation \(Internships\)](#)
[Field of Specialization / Field of Specialization: Robotics \(Internships\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-106693	Plug-and-Play Material Handling	4 CR	Furmans

Competence Certificate

The success control takes place as a study achievement in the form of a presentation of at least 10 minutes.

Prerequisites

None.

Competence Goal

- Naming and explaining the basics of plug-and-play conveyor technology
- Extend your knowledge of plug-and-play conveyor technology through independent research
- Applying the learned theory to a problem from practice
- Using the Software Framework ROS (Robot Operating System)
- Implementation of a decentralized communication protocol
- Designing components for additive manufacturing (3D printing)
- Evaluate developed solutions on the basis of logistical key figures

Content

- Theoretical basics and structure of plug-and-play conveyor technology
- Practical application of content in teamwork with mobile and stationary platforms
- Planning and implementation of a control system using the software framework ROS
- Definition, design and implementation of interfaces between teams and platforms
- Presentation of the work results and evaluation of these on the basis of logistical key figures

Workload

regular attendance: 80 hours

self-study: 40 hours

Learning type

seminar

M**6.166 Module: Power Electronic Systems in Energy Technology [M-ETIT-106067]****Responsible:** Prof. Dr.-Ing. Marc Hiller**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-112286	Power Electronic Systems in Energy Technology	6 CR	Hiller

Prerequisites

none

M**6.167 Module: Power Electronics [M-ETIT-104567]****Responsible:** Prof. Dr.-Ing. Marc Hiller**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(mandatory\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-109360	Power Electronics	6 CR	Hiller

Competence Certificate

The examination takes place in form of a written examination lasting 120 minutes.

Prerequisites

None

Competence Goal

Students will be familiar with state-of-the-art power semiconductors including their application related features. Furthermore students will be familiar with the circuit topologies for DC/DC and DC/AC power conversion. They know the associated modulation and control methods and characteristics. They are able to analyze the circuit topologies with regard to harmonics and power losses. This also includes the thermal design of power electronic circuits. In addition, they are able to select and combine suitable circuits for given electrical energy conversion requirements.

Content

In the lecture, power electronic circuits for DC/DC and DC/AC power conversion using IGBTs and MOSFETs are presented and analyzed. First, the basic properties of self-commutated circuits under idealized conditions are elaborated using the DC/DC converter as an example. Then, self-commutated power converters for three-phase applications are presented and analyzed with respect to modulation and their AC and DC terminal behavior. Based on the real power semiconductor behavior in on- and off-state the device losses are calculated. Furthermore the thermal design of power converters is explained using thermal equivalent circuits of power devices and cooling equipment. The voltage and current stress on the power semiconductors in switching operation is explained as well as protective snubber circuits allowing a reliable operation within the safe operating area of the devices.

In detail, the following topics are treated:

- Power Semiconductors
- Commutation principles
- DC/DC converters
- Self-commutated 1ph and 3ph DC/AC inverters
- Modulation methods (Fundamental frequency modulation, Pulse width modulation with 3rd harmonic injection, Space vector modulation)
- Multilevel inverters
- Switching behavior in hard and soft switching applications
- Loss calculation
- Thermal equivalent circuits, thermal design
- Snubber circuits.

The lecturer reserves the right to adapt the contents of the lecture to current needs without prior notice.

Module grade calculation

The module grade is the grade of the written exam.

Workload

14x lecture and 14x exercise à 2 h = 56 h

14x wrap-up of the lecture à 1 h = 14 h

14x preparation of the exercise à 2 h = 28 h

Preparation for the exam = 75 h

Examination time = 2 h

Total = approx. 175 h (corresponds to 6 LP)

M**6.168 Module: Power Electronics for Photovoltaics and Wind Energy [M-ETIT-102261]****Responsible:** Prof. Dr.-Ing. Marc Hiller**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
2

Mandatory			
T-ETIT-104569	Power Electronics for Photovoltaics and Wind Energy	3 CR	Hiller

Prerequisites

none

M**6.169 Module: Power Network [M-ETIT-100572]****Responsible:** Prof. Dr.-Ing. Thomas Leibfried**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(mandatory\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100830	Power Network	6 CR	Leibfried

M**6.170 Module: Power Systems and Economy [M-ETIT-100413]****Responsible:** Dr.-Ing. Bernd Hoferer**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-ETIT-100725	Power Systems and Economy	3 CR	Hoferer

Prerequisites

none

M**6.171 Module: Power Transmission and Power Network Control [M-ETIT-100534]****Responsible:** Prof. Dr.-Ing. Thomas Leibfried**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
5**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1

Mandatory			
T-ETIT-101941	Power Transmission and Power Network Control	5 CR	Leibfried

Prerequisites

none

M**6.172 Module: Practical Aspects of Electrical Drives [M-ETIT-100394]****Responsible:** Prof. Dr. Martin Doppelbauer**Organisation:** KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(mandatory\)](#)
[Interdisciplinary Subject](#)

Credits
 4

Grading scale
 Grade to a tenth

Recurrence
 Each summer term

Duration
 1 term

Language
 German

Level
 4

Version
 1

Mandatory			
T-ETIT-100711	Practical Aspects of Electrical Drives	4 CR	Doppelbauer

Prerequisites

none

M**6.173 Module: Practical Course: Machine Learning and Intelligent Systems [M-INFO-105958]**

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: [Interdisciplinary Subject](#)

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

Mandatory			
T-INFO-112104	Practical Course: Machine Learning and Intelligent Systems	8 CR	Fennel, Hanebeck

M**6.174 Module: Practical Course: Smart Energy System Lab [M-INFO-105955]****Responsible:** Prof. Dr. Veit Hagenmeyer**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(Internships\)](#)
Interdisciplinary Subject**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each term**Duration**
1 term**Language**
German/English**Level**
4**Version**
1

Mandatory			
T-INFO-112030	Practical Course: Smart Energy System Lab	6 CR	Waczowicz

M**6.175 Module: Practical Project Robotics and Automation I (Software) [M-INFO-102224]**

Responsible: Prof. Dr.-Ing. Björn Hein
Prof. Dr.-Ing. Thomas Längle

Organisation: KIT Department of Informatics

Part of: [Field of Specialization / Field of Specialization: Robotics \(Internships\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-INFO-104545	Practical Project Robotics and Automation I (Software)	6 CR	Hein, Längle

Modeled Conditions

You have to fulfill one of 2 conditions:

1. The module [M-INFO-102522 - Robotics - Practical Course](#) must not have been started.
2. The module [M-INFO-102230 - Practical Project Robotics and Automation II \(Hardware\)](#) must not have been started.

M**6.176 Module: Practical Project Robotics and Automation II (Hardware) [M-INFO-102230]**

Responsible: Prof. Dr.-Ing. Björn Hein
Prof. Dr.-Ing. Thomas Längle

Organisation: KIT Department of Informatics

Part of: [Field of Specialization / Field of Specialization: Robotics \(Internships\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-INFO-104552	Practical Project Robotics and Automation II (Hardware)	6 CR	Hein, Längle

Modeled Conditions

You have to fulfill one of 2 conditions:

1. The module [M-INFO-102522 - Robotics - Practical Course](#) must not have been started.
2. The module [M-INFO-102224 - Practical Project Robotics and Automation I \(Software\)](#) must not have been started.

M**6.177 Module: Practical Training in Basics of Microsystem Technology [M-MACH-105479]****Responsible:** Dr. Arndt Last**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Microsystems Technology \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-102164	Practical Training in Basics of Microsystem Technology	4 CR	Last

Competence Certificate

Written exam, 60 min.

Prerequisites

None

Competence Goal

Insight into the real, practical work at the Institute of Microstructure Technology.

Content

In the practical training includes nine experiments:

1. Hot embossing of plastics micro structures
2. Micro electroforming
3. X-ray optics
4. UV-lithography
5. Fluidic polymer components by example of a microfluidic mixer
6. Additive prototyping of microstructures
7. Introduction to SAW biosensors
8. Light diffraction at photomasks
9. Atomic force microscopy
10. Centrifugal microfluidics

Each student takes part in only five experiments.

The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Annotation

The internship takes place in the laboratories of the IMT at the CN. Meeting place: Building 307, room 322.

Participation requests to Mrs. Novotny, marie.nowotny@kit.edu**Workload**

regular attendance: 20 hours

self-study: 100 hours, Preparation of the five experiments

Recommendation

Attend at least one of the lectures Micro System Technology I or II.

Read the practical course documents provided as pdf-file!

Learning type

Lab, Self-study of the internship documents and guided experiments during the course.

LiteratureMadou, M. (2003). *Fundamentals of Microfabrication*. CRC. [ISBN 978-0849308260](#).

Practical course documents provided as pdf-file.

M**6.178 Module: Principles of Medicine for Engineers [M-MACH-102720]****Responsible:** apl. Prof. Dr. Christian Pylatiuk**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Medical Technology \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105235	Principles of Medicine for Engineers	4 CR	Pylatiuk

Competence Certificate

A performance assessment is held in form of a written examination of 45 minutes.

Prerequisites

none

Competence Goal

Students have a comprehensive understanding of the functioning and anatomical construction of organs, which are assigned to different medical disciplines. Furthermore, they know the physical basics, the technical solutions and the essential aspects of the application of medical technology procedures in diagnostics and therapy. They are familiar with common clinical pictures in the different medical disciplines and their relevance in health care. Through their acquired knowledge, students can communicate with physicians about medical-technical procedures and assess mutual expectations more realistically.

Content

Definition of disease and health and history of medicine, evidence-based medicine" and personalized medicine, nervous system, conduction, musculoskeletal system, cardiovascular system, anesthesia, respiratory system, sensory organs, gynecology, digestive organs, surgery, nephrology, orthopedics, immune system, genetics.

Module grade calculation

The module grade is the grade of the written exam.

Workload

1. Attendance time Lecture: $15 \cdot 2h = 30h$
2. Pre- and postprocessing time Lecture: $15 \cdot 3h = 45h$
3. Exam preparation and attendance exam: 45h

Total: 120h = 4 LP

Recommendation

The content of module MMACH-105228 complements this lecture.

Literature

- Adolf Faller, Michael Schünke: Der Körper des Menschen. Thieme Verlag.
- Renate Huch, Klaus D. Jürgens: Mensch Körper Krankheit. Elsevier Verlag.

M**6.179 Module: Principles of Whole Vehicle Engineering I [M-MACH-105289]**

Responsible: Prof.Dipl.-Ing. Rolf Frech
Dr.-Ing. Hans-Joachim Unrau

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105162	Fundamentals of Automobile Development I	2 CR	Frech

Competence Certificate

The assessment is carried out as partial exams (according to Section 4(2) of the examination regulation) 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.

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 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.

Content

1. Process of automobile development
2. Conceptual dimensioning and design of an automobile
3. Laws and regulations – National and international boundary conditions
4. Aero dynamical dimensioning and design of an automobile I
5. Aero dynamical dimensioning and design of an automobile II
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

Workload

The total work load for this module is about 60 Hours (2 Credits). The partition of the work load is carried out according to the credit points of the courses of the module. The work load for courses with 2 credit points is about 60 hours.

Learning type

Lecture

M**6.180 Module: Principles of Whole Vehicle Engineering II [M-MACH-105290]**

Responsible: Prof.Dipl.-Ing. Rolf Frech
Dr.-Ing. Hans-Joachim Unrau

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105163	Fundamentals of Automobile Development II	2 CR	Frech

Competence Certificate

The assessment is carried out as partial exams (according to Section 4(2) of the examination regulation) 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.

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 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

Content

1. Application-oriented material and production technology I
2. Application-oriented material and production technology II
3. Overall vehicle acoustics in the automobile development
4. Drive train acoustics in the automobile development
5. Testing of the complete vehicle
6. Properties of the complete automobile

Workload

The total work load for this module is about 60 Hours (2 Credits). The partition of the work load is carried out according to the credit points of the courses of the module. The work load for courses with 2 credit points is about 60 hours.

Learning type

Lecture

M**6.181 Module: Product Development – Methods of Product Engineering [M-MACH-102718]**

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

Part of: [General Mechatronics](#)
[Interdisciplinary Subject](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German/English	4	2

Mandatory			
T-MACH-109192	Methods and Processes of PGE - Product Generation Engineering	6 CR	Albers, Burkardt, Matthiesen

Competence Certificate

Written examination (processing time: 120 min + 10 min reading time)

Prerequisites

None

Competence Goal

The students are able to ...

- classify product development in companies and differentiate between different types of product development.
- name the relevant influencing factors of a market for product development.
- name, compare and use the central methods and process models of product development within moderate complex technical systems.
- explain problem solving techniques and associated development methods.
- explain product profiles and to differentiate and choose suitable creative techniques of solution/idea generation finding on this basis.
- use design guidelines to create simple technical systems and to explain these guidelines.
- name and compare quality assurance methods; to choose and use suitable methods for particular applications.
- explain the different methods of design of experiment.
- explain the costs in development process.

Content

Basics of Product Development: Basic Terms, Classification of the Product

Development into the industrial environment, generation of costs / responsibility for costs

Concept Development: List of demands / Abstraction of the Problem Definition / Creativity Techniques / Evaluation and selection of solutions

Drafting : Prevailing basic rules of Design / Design Principles as a problem oriented accessory

Rationalization within the Product Development: Basics of Development

Management/ Simultaneous Engineering and Integrated Product Development/Development of Product Lines and Modular Construction Systems

Quality Assurance in early Development Phases : Methods of Quality Assurance in an overview/QFD/FMEA

Workload

1. Time of presence lecture: 15 * 3h = 45 h

2. Prepare/follow-up lecture: 15 * 4,5 h = 67,5 h

3. Time of presence exercise: 4 * 1,5h = 6 h

4. Prepare/follow-up exercise: 4 * 3 h = 12 h

5. Exam preparation and time of presence: 49,5 h

Total: 180 h = 6 LP

Learning type

Lecture

Tutorial

Literature

Lecture documents

Pahl, Beitz: Konstruktionslehre, Springer-Verlag 1997

Hering, Triemel, Blank: Qualitätssicherung für Ingenieure; VDI-Verlag, 1993

M**6.182 Module: Production Techniques Laboratory [M-MACH-102711]**

Responsible: Prof. Dr.-Ing. Barbara Deml
 Prof. Dr.-Ing. Kai Furmans
 Prof. Dr.-Ing. Jivka Ovtcharova
 Prof. Dr.-Ing. Volker Schulze

Organisation: KIT Department of Mechanical Engineering

Part of: Field of Specialization / Field of Specialization: Design of Mechatronic Systems (Internships)
 Interdisciplinary Subject

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

Mandatory			
T-MACH-105346	Production Techniques Laboratory	4 CR	Deml, Fleischer, Furmans, Ovtcharova

Competence Certificate

A performance assessment (non-graded) is obligatory and can be oral, a written exam, or of another kind.

Prerequisites

None

Competence Goal

The students acquire in the lab profound knowledge about the scientific theories, principles and methods of Production Engineering. Afterwards they are able to evaluate and design complex production systems according to problems of manufacturing and process technologies, materials handling, handling techniques, information engineering as well as production organisation and management.

After completion this lab, the students are able

- to analyse and solve planning and layout problems of the discussed fields,
- to evaluate and configure the quality and efficiency of production, processes and products,
- to plan, control and evaluate the production of a production enterprise,
- to configure and evaluate the IT architecture of a production enterprise,
- to design and evaluate appropriate techniques for conveying, handling and picking within a production system,
- to design and evaluate the part production and the assembly by considering the work processes and the work places.

Content

The production technique laboratory (PTL) is a collaboration of the institutes wbk, IFL, IMI and ifab.

1. Computer Aided Product Development (IMI)
2. Computer communication in factory (IMI)
3. Production of parts with CNC turning machines (wbk)
4. Controlling of production systems using PLCs (wbk)
5. Automated assembly systems (wbk)
6. Optical identification in production and logistics (IFL)
7. RFID identification systems (IFL)
8. Storage and order-picking systems (IFL)
9. Design of workstations (ifab)
10. Time study (ifab)
11. Accomplishment of workplace design (ifab)

Workload

Present time: 20 h

Self study: 100 h

Learning type

Seminar

Literature

Handout and literature online ILIAS.

M**6.183 Module: Project Management in the Development of Products for Safety-Critical Applications [M-ETIT-104475]****Responsible:** Dr.-Ing. Manfred Nolle**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(mandatory\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-ETIT-109148	Project Management in the Development of Products for Safety-Critical Applications	4 CR	Nolle



6.184 Module: Quality Management [M-MACH-105332]

Responsible: Prof. Dr.-Ing. Gisela Lanza

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-102107	Quality Management	4 CR	Lanza

Competence Certificate

Written Exam (60 min)

Prerequisites

None

Competence Goal

The students ...

- are capable to comment on the content covered by the module.
- are capable of substantially quality philosophies.
- are able to apply the QM tools and methods they have learned about in the module to new problems from the context of the module.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about in the module for a specific problem.

Content

Based on the quality philosophies Total Quality Management (TQM) and Six-Sigma, the module will specifically address the needs of a modern quality management. The process orientation in a modern company and the process-specific fields of quality assurance are presented in detail. Preventive as well as non-preventive quality management methods, which are state of the art in operational practice today, are content of the module. The use of suitable measurement techniques in production engineering (production measurement technology) as well as their potential levels of integration in the production system are discussed. The use of suitable statistical methods for data analysis and their modern extension by methods of artificial intelligence are be discussed. The contents are complemented by legal aspects in the field of quality management.

Main topics of the module:

- The term "Quality"
- Total Quality Management (TQM)
- Six-Sigma and universal methods and tools within the DMAIC cycle
- QM in early product stages – Determination and realization of customer requirements
- QM in product development
- Production measurement Technology
- QM in production - statistical Methods
- Artificial intelligence and machine learning in quality Management
- Operating behaviour and reliability
- Legal aspects in QM

Workload

1. Presence time lecture: $15 * 2 \text{ h} = 30 \text{ h}$
 2. Pre- and post-processing time lecture: $15 * 3 \text{ h} = 45 \text{ h}$
 3. Exam preparation and presence in the same: 45 h
- In total: 120 h = 4 LP

Learning type

Lecture

M**6.185 Module: Rail System Technology [M-MACH-103232]****Responsible:** Prof. Dr.-Ing. Martin Cichon**Organisation:** KIT Department of Mechanical Engineering**Part of:** Field of Specialization / Field of Specialization: Automotive Engineering (Complementary Modules)
Interdisciplinary Subject

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

Mandatory			
T-MACH-106424	Rail System Technology	4 CR	Cichon

Competence Certificate

Oral examination

Duration ca. 20 minutes

No tools or reference materials may be used during the exam.

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.

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

Annotation

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

Workload

Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

total: 120 hours = 4 ECTS

Learning type

Lecture

M**6.186 Module: Rail Vehicle Technology [M-MACH-102683]****Responsible:** Prof. Dr.-Ing. Martin Cichon**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Automotive Engineering \(mandatory\)](#)
[Interdisciplinary Subject](#)**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each term**Duration**
1 term**Language**
German**Level**
4**Version**
2

Mandatory			
T-MACH-105353	Rail Vehicle Technology	4 CR	Cichon

Competence Certificate

Oral examination

Duration ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites

none

Competence Goal

- The students learn the role of rail vehicles and understand their classification. They understand the basic structure and 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 judge 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.

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: principles, 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

Annotation

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

Workload

Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

total: 120 hours = 4 ECTS

Learning type

Lecture

M**6.187 Module: Real Time Control of Electrical Drives [M-ETIT-105916]****Responsible:** Dr.-Ing. Andreas Liske**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-ETIT-111898	Real Time Control of Electrical Drives	6 CR	Liske

Workload

Jeder Leistungspunkt (Credit Point) entspricht ca. 25-30h Arbeitsaufwand (des Studierenden). Hierbei ist vom durchschnittlichen Studierenden auszugehen, der eine durchschnittliche Leistung erreicht.

56h = 22x V à 2h + 3x Ü à 4h

21h = 21x Nachbereitung von V à 1 h

12h = 3x Vorbereitung von Ü à 4 h

80h = Vorbereitung zur Prüfung

Summe = 169 h (entspricht 6 LP)

M**6.188 Module: Real-Time Systems [M-INFO-100803]****Responsible:** Prof. Dr.-Ing. Thomas Längle**Organisation:** KIT Department of Informatics

Part of: [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-INFO-101340	Real-Time Systems	6 CR	Längle

M**6.189 Module: Reinforcement Learning [M-INFO-105623]****Responsible:** Prof. Dr. Gerhard Neumann**Organisation:** KIT Department of Informatics

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

Credits
 5

Grading scale
 Grade to a tenth

Recurrence
 Each winter term

Duration
 1 term

Language
 English

Level
 4

Version
 1

Mandatory			
T-INFO-111255	Reinforcement Learning	5 CR	Neumann

Competence Certificate

See partial achievements (Teilleistung)

Prerequisites

See partial achievements (Teilleistung)

Competence Goal

- Students are able to understand the RL problem and challenges.
- Students can differentiate between different RL algorithm and understand their underlying theory
- Students will know the mathematical tools necessary to understand RL algorithms
- Students can implement RL algorithms for various tasks
- Students understand current research questions in RL

Content

Reinforcement Learning (RL) is a sub-field of machine learning in which an artificial agent has to interact with its environment and learn how to improve its behaviour by trial and error. For doing so, the agent is provided with an evaluative feedback signal, called reward, that he perceives for each action performed in its environment. RL is one of the hardest machine learning problems, as, in contrast to standard supervised learning, we do not know the targets (i.e. the optimal actions) for our inputs (i.e. the state of the environment) and we also need to consider the long-term effects of the agent's actions on the state of the environment. Due to recent successes, RL has gained a lot of popularity with applications in robotics, automation, health care, trading and finance, natural language processing, autonomous driving and computer games. This lecture will introduce the concepts and theory of RL and review current state of the art methods with a particular focus on RL applications in robotics. An exemplary list of topics is given below:

- Primer in Machine Learning and Deep Learning
- Supervised Learning of Behaviour
- Introduction in Reinforcement Learning
- Dynamic Programming
- Value Based Methods
- Policy Optimization and Trust Regions
- Episodic Reinforcement Learning and Skill Learning
- Bayesian Optimization
- Variational Inference, Max-Entropy RL and Versatility
- Model-based Reinforcement Learning
- Offline Reinforcement Learning
- Inverse Reinforcement Learning
- Hierarchical Reinforcement Learning
- Exploration and Artificial Curiosity
- Meta Reinforcement Learning

Workload

Approximately 150 hours, divided into:

- 30 hours of lecture attendance
- 15 hours of exercise attendance
- 75 hours of post-processing and working on exercise sheets
- 30 hours of exam preparation.

Recommendation

- Students should be familiar with the content of the "Foundations of Artificial Intelligence" lecture.
- Good Python knowledge is required.
- Good mathematical background knowledge is required.

M**6.190 Module: Reliability and Test Engineering [M-MACH-106050]**

Responsible: Dr.-Ing. Thomas Gwosch
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: Field of Specialization / Field of Specialization: Automotive Engineering (Internships)
Field of Specialization / Field of Specialization: Industrial Automation (Internships)
Field of Specialization / Field of Specialization: Control Engineering in Mechatronics (Internships)
Field of Specialization / Field of Specialization: Robotics (Internships)
Field of Specialization / Field of Specialization: Design of Mechatronic Systems (Internships)
Interdisciplinary Subject

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

Mandatory			
T-MACH-111840	Reliability and Test Engineering	5 CR	Gwosch

Competence Certificate

The grade is composed of the evaluation of a final report following the practical part. The assessment criteria are as follows:

- Structure of the report
- Comprehensibility and comprehensibility
- Preparation of the tests
- Use of test and reliability methods
- Formulation and answering of test hypotheses
- Test evaluation, comprehensible results

Attendance and active participation in the lab is mandatory.

Prerequisites

keine

Competence Goal

The students:

- know the relevance of reliability and test engineering in engineering practice.
- know the methods of reliability and test engineering and the components and tools used.
- are able to carry out test planning, test execution and test interpretation for a given problem on a test bench by themselves.

Content

The students learn the methods of reliability and test engineering and the components used. Furthermore, they are able to independently carry out test planning, test execution and test interpretation for a given problem on a test bench.

The following contents are taught in the lecture:

- Relevance of reliability and test engineering in the industry.
- Overview of test equipment
- Test strategies and statistical test planning
- Testing with hypotheses
- Reliability models

The implementation of test planning, test execution and test interpretation on a demonstrator test bench is part of the practical session subsequent to the lecture (See also Event 2145351: Workshop for Reliability and Test Engineering).

Module grade calculation

The module grade is the grade of the examination performance of another type.

Annotation

In case of questions please contact lrt@ipek.kit.edu

The number of participants is limited, an application is necessary. For details please check the lab's web page <https://www.ipek.kit.edu/2976.php>

Workload

150 h

Recommendation

We strongly recommend the attendance of the MSuP lectures. Students who have not (yet) attended are recommended to learn the contents in advance.

Learning type

Materials/lecture notes are supplied via ILIAS.

Literature

O'Connor: Test Engineering

O'Connor: Practical Reliability Engineering

Birolini: Reliability Engineering

Bertsche: Zuverlässigkeit mechatronischer Systeme

VDI 4002: Zuverlässigkeitsingenieur

M**6.191 Module: Renewable Energy-Resources, Technologies and Economics [M-WIWI-100500]**

Responsible: Prof. Dr. Russell McKenna
Organisation: KIT Department of Economics and Management
Part of: [Interdisciplinary Subject](#)

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

Mandatory			
T-WIWI-100806	Renewable Energy-Resources, Technologies and Economics	4 CR	Jochem

Competence Certificate

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

Prerequisites

None

Competence Goal

The student:

- understands the motivation and the global context of renewable energy resources.
- gains detailed knowledge about the different renewable resources and technologies as well as their potentials.
- understands the systemic context and interactions resulting from the increased share of renewable power generation.
- understands the important economic aspects of renewable energies, including electricity generation costs, political promotion and marketing of renewable electricity.
- is able to characterize and where required calculate these technologies.

Content

1. General introduction: Motivation, Global situation
2. Basics of renewable energies: Energy balance of the earth, potential definition
3. Hydro
4. Wind
5. Solar
6. Biomass
7. Geothermal
8. Other renewable energies
9. Promotion of renewable energies
10. Interactions in systemic context
11. Excursion to the "Energieberg" in Mühlburg

Workload

The total workload for this course is approximately 105.0 hours. For further information see German version.

Literature**Elective literature:**

- Kaltschmitt, M., 2006, Erneuerbare Energien : Systemtechnik, Wirtschaftlichkeit, Umweltaspekte, aktualisierte, korrigierte und ergänzte Auflage Berlin, Heidelberg : Springer-Verlag Berlin Heidelberg.
- Kaltschmitt, M., Streicher, W., Wiese, A. (eds.), 2007, Renewable Energy: Technology, Economics and Environment, Springer, Heidelberg.
- Quaschnig, V., 2010, Erneuerbare Energien und Klimaschutz : Hintergründe - Techniken - Anlagenplanung - Wirtschaftlichkeit München : Hanser, Ill.2., aktualis. Aufl.
- Harvey, D., 2010, Energy and the New Reality 2: Carbon-Free Energy Supply, Eathscan, London/Washington.
- Boyle, G. (ed.), 2004, Renewable Energy: Power for a Sustainable Future, 2nd Edition, Open University Press, Oxford.



6.192 Module: Robotics - Practical Course [M-INFO-102522]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [Field of Specialization / Field of Specialization: Robotics \(Internships\)](#)
 Interdisciplinary Subject

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

Mandatory			
T-INFO-105107	Robotics - Practical Course	6 CR	Asfour

Competence Certificate

See partial Achievements (Teilleistung)

Prerequisites

See partial Achievements (Teilleistung)

Modeled Conditions

You have to fulfill one of 2 conditions:

1. The module [M-INFO-102224 - Practical Project Robotics and Automation I \(Software\)](#) must not have been started.
2. The module [M-INFO-102230 - Practical Project Robotics and Automation II \(Hardware\)](#) must not have been started.

Competence Goal

The student knows concrete solutions for different problems in robotics. He/she uses methods of inverse kinematics, grasp and motion planning, and visual perception. The student can implement solutions in the programming language C++ with the help of suitable software frameworks.

Content

The practical course is offered as an accompanying course to the lectures Robotics I-III. Every week, a small team of students will work on solving a given robotics problem. The list of topics includes robot modeling and simulation, inverse kinematics, robot programming via state charts, collision-free motion planning, grasp planning, robot vision and robot learning.

Workload

Practical course with 4 SWS, 6 LP
 6 LP corresponds to 180 hours, including
 2 hours introductory event
 18 hours initial familiarization with the software framework
 120 hours group work
 40 hours attendance time

Recommendation

Attending the lectures Robotics I – Introduction to Robotics, Robotics II: Humanoid Robotics, Robotics III - Sensors and Perception in Robotics and Mechano-Informatics and Robotics is recommended.

M**6.193 Module: Robotics I - Introduction to Robotics [M-INFO-100893]****Responsible:** Prof. Dr.-Ing. Tamim Asfour**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Robotics \(mandatory\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-INFO-108014	Robotics I - Introduction to Robotics	6 CR	Asfour

Competence Certificate

See partial achievements (Teilleistung)

Prerequisites

See partial achievements (Teilleistung)

Competence Goal

The student is 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 student masters the kinematic and dynamic modeling of robot systems, as well as the modeling and design of simple controllers. The student knows the algorithmic basics of motion and grasp planning and can apply these algorithms to problems in robotics. He/she knows algorithms from the field of image processing and is able to apply them to problems in robotics. He/she is able to model and solve tasks as a symbolic planning problem. The student has knowledge about intuitive programming procedures for robots and knows procedures for programming and learning by demonstration.

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

M**6.194 Module: Robotics II - Humanoid Robotics [M-INFO-102756]**

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [Field of Specialization / Field of Specialization: Robotics \(mandatory\)](#)
 Interdisciplinary Subject

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	Grade to a tenth	Each summer term	1 term	German/English	4	2

Mandatory			
T-INFO-105723	Robotics II - Humanoid Robotics	3 CR	Asfour

Competence Certificate

See partial achievements (Teilleistung)

Prerequisites

See partial achievements (Teilleistung)

Competence Goal

The students have an overview of current research topics in autonomous learning robot systems using the example of humanoid robotics. They are able to classify and evaluate current developments in the field of cognitive humanoid robotics. The students know the essential problems of humanoid robotics and are able to develop solutions on the basis of existing research.

Content

The lecture presents current work in the field of humanoid robotics that deals with the implementation of complex sensorimotor and cognitive abilities. In the individual topics different methods and algorithms, their advantages and disadvantages, as well as the current state of research are discussed.

The topics addressed are: Applications and real world examples of humanoid robots; biomechanical models of the human body, biologically inspired and data-driven methods of grasping, imitation learning and programming by demonstration; semantic representations of sensorimotor experience as well as cognitive software architectures of humanoid robots.

Workload

Vorlesung mit 2 SWS, 3 LP.

3 LP entspricht ca. 90 Stunden, davon

ca. 15 * 2h = 30 Std. Präsenzzeit Vorlesung

ca. 15 * 2h = 30 Std. Vor- und Nachbereitungszeit Vorlesung

ca. 30 Std. Prüfungsvorbereitung und Präsenz in selbiger

Recommendation

Robotik I – Einführung in die Robotik and *Mechano-Informatik in der Robotik* is recommended.

M**6.195 Module: Robotics III - Sensors and Perception in Robotics [M-INFO-104897]**

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [Field of Specialization](#) / [Field of Specialization: Robotics \(mandatory\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-INFO-109931	Robotics III - Sensors and Perception in Robotics	3 CR	Asfour

Competence Certificate

See partial achievements (Teilleistung)

Prerequisites

See partial achievements (Teilleistung)

Competence Goal

The student can name the main sensor principles used in robotics.

The student can explain the data flow from physical measurement through digitization to the use of the recorded data for feature extraction, state estimation and semantic scene understanding.

The student is able to propose and justify suitable sensor concepts for common tasks in robotics.

Content

The lecture supplements the lecture Robotics I with a broad overview of sensors used in robotics. The lecture focuses on visual perception, object detection, simultaneous localization and mapping (SLAM) and semantic scene interpretation. The lecture is divided into two parts:

In the first part a comprehensive overview of current sensor technologies is given. A basic distinction is made between sensors for the perception of the environment (exteroceptive) and sensors for the perception of the internal state (proprioceptive).

The second part of the lecture concentrates on the use and interpretation of exteroceptive sensors in robotics. The topics covered include tactile exploration and visual data processing, including advanced topics such as feature extraction, object detection, simultaneous localization and mapping (SLAM) and semantic scene understanding.

Workload

Lecture with 2 SWS, 3 LP

3 LP corresponds to 90 hours, including

15 * 2 = 30 hours attendance time

15 * 2 = 30 hours self-study

30 hours preparation for the exam

Recommendation

Attending the lecture Robotics I – Introduction to Robotics is recommended.

M**6.196 Module: Seamless Engineering [M-MACH-105725]**

Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Eric Sax

Organisation: KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Internships\)](#)
[Field of Specialization / Field of Specialization: Power Engineering \(Internships\)](#)
[Field of Specialization / Field of Specialization: Microsystems Technology \(Internships\)](#)
[Field of Specialization / Field of Specialization: Industrial Automation \(Internships\)](#)
[Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Internships\)](#)
[Field of Specialization / Field of Specialization: Robotics \(Internships\)](#)
[Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Internships\)](#)
[Interdisciplinary Subject](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
9	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-MACH-111401	Seamless Engineering	9 CR	Furmans, Sax

Competence Certificate

Examination of another type. The module grade is the grade of the brick. The description of the form of examination can be found in the description of the partial performance.

Prerequisites

None

Competence Goal

After successful completion of the course, the students are able to model and parameterise the requirements and boundary conditions for typical mechatronic systems. In addition, students learn the ability to select the appropriate procedures, processes, methods and tools for the development of a mechatronic system.

Important core competences in the areas of communication, problem solving and self-organisation are further essential components of the workshop, which enable the students to do reflected work independently and in a team.

Content

This module is designed to teach students how to develop a heterogeneous integrated mechatronic system. In the lecture, students are introduced to a system-oriented, higher-level approach to the description, assessment and development of a mechatronic system.

Parallel to this, the contents taught are applied and deepened in the practical part on hardware that is close to industry. The students learn the systematic development in a simulative environment as well as the transition from simulation to real hardware.

To achieve this, important components of software development in the robotics environment are taught. This includes, among other things, the basics of programming (Python) as well as the handling of the framework "Robot Operating System (ROS)". In addition, students gain insights into the use of sensors and actuators, image processing, autonomous navigation of automated guided vehicles and robotic grasping.

Annotation

None

Workload

1. attendance time lecture and exercise: 45 h
2. interdisciplinary qualification: 45 h
3. group work project: 130 h
4. colloquia and final event: 30 h
5. exam preparation and presence in the same: 20 h

In total: 270 = 9 LP

Recommendation

None

Learning type

Lecture, exercise, project.

Literature

None

M**6.197 Module: Seminar Accessibility - Assistive Technologies for Visually Impaired Persons [M-INFO-102374]****Responsible:** Prof. Dr.-Ing. Rainer Stiefelhagen**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization](#) / [Field of Specialization: Medical Technology \(Complementary Modules\)](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
2

Mandatory			
T-INFO-104742	Seminar Accessibility - Assistive Technologies for Visually Impaired Persons	3 CR	Stiefelhagen

M**6.198 Module: Seminar Data-Mining in Production [M-MACH-105477]****Responsible:** Prof. Dr.-Ing. Gisela Lanza**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Industrial Automation \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-108737	Seminar Data-Mining in Production	3 CR	Lanza

Competence Certificate

Alternative test achievement

Prerequisites

None

Competence Goal

The students ...

- can name, describe and distinguish between different methods, procedures and techniques of production data analysis.
- can perform basic data analyses with the data mining tool KNIME.
- can analyze and evaluate the results of data analyses in the production environment.
- are able to derive suitable recommendations for action.
- are able to explain and apply the CRISP-DM model.

Content

In the age of Industry 4.0, large amounts of production data are generated by the global production networks and value chains. Their analysis enables valuable conclusions about production and lead to an increasing process efficiency. The aim of the module is to get to know production data analysis as an important component of future industrial projects. The students get to know the data mining tool KNIME and use it for analyses. A specific industrial use case with real production data enables practical work and offers direct references to industrial applications. The participants learn selected methods of data mining and apply them to the production data. The work within the seminar takes place in small groups on the computer. Subsequently, presentations on specific data mining methods have to be prepared.

Annotation

The number of students is limited to twelve. Dates and deadlines for the seminar will be announced at <https://www.wbk.kit.edu/studium-und-lehre.php>.

Workload

regular attendance: 10 hours

self-study: 80 hours

Learning type

Seminar

M**6.199 Module: Seminar Embedded Systems [M-ETIT-100455]**

Responsible: Prof. Dr.-Ing. Jürgen Becker
 Prof. Dr.-Ing. Eric Sax
 Prof. Dr. Wilhelm Stork

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100753	Seminar Embedded Systems	3 CR	Becker, Sax, Stork

Competence Certificate

Type of examination: alternative exam assessment. The examination consists of a written report and an oral presentation. The overall impression is rated.

Prerequisites

none

M**6.200 Module: Seminar for Rail System Technology [M-MACH-104197]****Responsible:** Prof. Dr.-Ing. Martin Cichon**Organisation:** KIT Department of Mechanical Engineering**Part of:** Interdisciplinary Subject

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

Mandatory			
T-MACH-108692	Seminar for Rail System Technology	3 CR	Cichon

Competence Certificate

Examination: Writing an essay (Seminararbeit), final presentation

Prerequisites

None

Competence Goal

- 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.

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.

Workload

Regular attendance: 21 hours

Self-study (writing Seminararbeit): 65 hours

Final presentation (including preparation): 4 hours

total: 90 hours = 3 ECTS

Learning type

Essay

M**6.201 Module: Seminar Intelligent Industrial Robots [M-INFO-102212]****Responsible:** Prof. Dr.-Ing. Heinz Wörn**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization](#) / [Field of Specialization: Robotics \(Complementary Modules\)](#)

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

Mandatory			
T-INFO-104526	Seminar Intelligent Industrial Robots	3 CR	Wörn

M**6.202 Module: Seminar Novel Concepts for Solar Energy Harvesting [M-ETIT-103447]****Responsible:** Prof. Dr. Bryce Sydney Richards**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	Grade to a tenth	Each summer term	1 term	English	4	2

Mandatory			
T-ETIT-108344	Seminar Novel Concepts for Solar Energy Harvesting	3 CR	Richards

Competence Certificate

The examination consists of a written journal article and an oral presentation of the student's work, both given in English. The overall impression is rated.

Prerequisites

none

Competence Goal

After completion of the seminar, students are able to independently familiarize themselves with a new research topic, recapitulate the corresponding literature and present the topic in the form of a review journal article as well as an oral overview presentation. Besides the exposure to new scientific research topics, the students will develop their know-how in scientific presentations and scientific writing in English which are key competences for their future (e.g. MSc thesis projects and research).

Content

We are offering an advanced seminar on „Novel Concepts for Solar Energy Harvesting“ for students curious in latest research topics on devices, materials and physics of next generation solar energy harvesting. The students will get the opportunity to familiarize themselves with a state-of-the-art research topic of their choice under the guidance of a mentor and present the topic during the seminar. The students must attend the seminar regularly, present the research topic in a 30-min scientific talk and submit a short scientific paper (3-5 pages). The seminar addresses master students from electrical engineering, physics, mechanical engineering, material science, KSOP and related MSc programs.

Module grade calculation

The module grade results of the assessment of the written paper and the oral presentation. Details will be given during the lecture.

Workload

1. participation in the seminar lectures: 22,5 h
2. preparation of the seminar presentation: 50 h
3. preparation of the journal article: 47,5 h

Recommendation

Good knowledge of semiconductor components/optoelectronics is desirable.

M**6.203 Module: Seminar on Quantum Detectors and Sensors [M-ETIT-105607]****Responsible:** Prof. Dr. Sebastian Kempf**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
Interdisciplinary Subject

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

Mandatory			
T-ETIT-111235	Seminar on Quantum Detectors and Sensors	3 CR	Kempf

Prerequisites

none

M**6.204 Module: Seminar Radar and Communication Systems [M-ETIT-100428]**

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-100736	Seminar Radar and Communication Systems	4 CR	Zwick

Competence Certificate

The performance evaluation takes place by means of an overall examination according to § 4 Paragraph 2 No. 3 SPO-MA-2015, 2018 of the selected courses, the sum total of which fulfills the minimum requirement of course credits.

The examination takes place in the form of submission of a written report (paper) along with an oral presentation of the individual work.

Both are taken into account, while grading the examination performance. The overall impression will be evaluated.

Prerequisites

none

Competence Goal

The students are provided with an overview of a broad range of topics in the field of radio frequency engineering. You are in a position to work independently in the following areas: carrying out literature research, the art of holding lectures and presentations and writing research papers. You can work in a self-organized manner and acquire communicative, organizational and initial-level didactic skills. You are given the opportunity to work independently on a radio frequency engineering topic, to analyze the topic and present it in front of an expert audience.

Content

The seminar in particular offers the opportunity to learn and sharpen the skills of holding lectures and oral presentations, conducting literature research and writing research papers. Although these skills constitute a decisive qualification in the professional life, they are seldom promoted in other courses. The seminar provides a remedial action in this regard: each participant works independently on a topic (predominantly in english language) and presents it in front of an expert audience. In the final discussion, besides technical aspects, presentation style and written report are also taken into consideration.

Apart from presenting the topic, the required written report in LaTeX provides an excellent preparation for fulfilling the requirements of scientific and technical thesis works.

Module grade calculation

The course grade is calculated on the basis of the presentation as well as the written report. Both are taken into account for the performance evaluation. An assessment will be made based on the overall impression.

Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. The workload includes:

Literature research: 40 h

Writing of the paper: 40 h

Presentation including preparation: 40 h

A total of 120 h = 4 LP

Recommendation

Knowledge of fundamentals of radio frequency engineering are helpful.

M**6.205 Module: Seminar: Energy Informatics [M-INFO-103153]****Responsible:** Prof. Dr. Dorothea Wagner**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Irregular**Duration**
1 term**Language**
German/English**Level**
4**Version**
1**Mandatory**

T-INFO-106270	Seminar: Energy Informatics	4 CR	Wagner
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M**6.206 Module: Sensors [M-ETIT-100378]****Responsible:** Dr. Wolfgang Menesklou**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Microsystems Technology \(mandatory\)](#)
[Interdisciplinary Subject](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
2

Mandatory			
T-ETIT-101911	Sensors	3 CR	Menesklou

M**6.207 Module: Software Engineering [M-ETIT-100450]****Responsible:** Dr. Clemens Reichmann**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
2**Mandatory**

T-ETIT-108347	Software Engineering	3 CR	Reichmann
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Prerequisites

none

M**6.208 Module: Software Radio [M-ETIT-100439]****Responsible:** Dr.-Ing. Holger Jäkel**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Interdisciplinary Subject](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1**Prerequisites**

none

M**6.209 Module: Solar Energy [M-ETIT-100524]****Responsible:** Prof. Dr. Bryce Sydney Richards**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
English**Level**
4**Version**
1

Mandatory			
T-ETIT-100774	Solar Energy	6 CR	Richards

Competence Certificate

Type of Examination: written exam

Duration of Examination: 120 Minutes

Modality of Exam: One written exam at the end of each semester.

Prerequisites

Students not allowed to take either of the following modules in addition to this one: „Solarenergie“ (M-ETIT-100476) and „Photovoltaik“ (M-ETIT-100513).

Modeled Conditions

The following conditions have to be fulfilled:

1. The module [M-ETIT-100513 - Photovoltaics](#) must not have been started.

Competence Goal

The students:

- understand the basic working principle of pn-junction solar cells,
- learn about the different kinds of solar cells (crystalline and amorphous silicon, CIGS, Cadmium telluride, organic, dye-sensitized solar cells, etc.),
- get an overview over upcoming third-generation photovoltaic concepts,
- receive information on photovoltaic modules and module fabrication,
- develop an understanding of solar cell integration and feeding the electrical power to the grid,
- get insight into solar concentration and tandem solar cells for highly efficient energy conversion,
- compare photovoltaic energy harvesting with solar thermal technologies
- understand the environmental impact of solar energy technologies.

Die Studentinnen und Studenten können in englischer Fachsprache sehr gut kommunizieren.

Content**I. Introduction: The Sun****II. Semiconductor fundamentals****III. Solar cell working principle****IV. First Generation solar cells: silicon wafer based****V. Second Generation solar cells: thin films of amorphous silicon, copper indium gallium diselenide, cadmium telluride, organic photovoltaics and dye sensitized solar cells****V. Third Generation Photovoltaics: high-efficiency device concepts incl. tandem solar cells****VI. Modules and system integration****VII. Cell and module characterization techniques****VIII. Economics, energy pay-back time, environmental impact****IX. Other solar energy harvesting processes, incl. thermal and solar fuels****X. Excursion**

Module grade calculation

The module grade is the grade of the written exam.

Workload

Total 180 h, thereof 60h contact hours (45h lecture, 15h problems class), and 120h homework and self-studies

Recommendation

Knowledge of optoelectronics is a prerequisite, e.g. M-ETIT-100480 – Optoelektronik.

Literature

P. Würfel: Physics of Solar Cells

V. Quaschnig: Renewable Energy Systems

C. Honsberg and S. Bowden, PV Education CD-ROM and website, <http://www.pveducation.org/pvcdrom>

M**6.210 Module: Spaceborne Radar Remote Sensing [M-ETIT-103042]****Responsible:** Prof. Dr.-Ing. Thomas Zwick**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject****Credits**
6**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
English**Level**
4**Version**
1

Mandatory			
T-ETIT-106056	Spaceborne Radar Remote Sensing	6 CR	Zwick

Competence Certificate

Success control is carried out as part of a written overall examination (120 minutes) of the selected courses, which in total meet the minimum requirement for LP.

Written

Prerequisites

"M-ETIT-100426 - Spaceborne SAR Remote Sensing" is not allowed to be started or to be completed.

Competence Goal

The students obtain a sound knowledge on the fundamentals, theory and applications of spaceborne radar systems. They understand the principle and function of synthetic aperture radars (SAR). They are able to explain the theory, techniques, algorithms for data processing and system concepts as well as to report on several application examples.

Content

The lecture is interdisciplinary and well suited for students interested in learning different aspects of the entire end-to-end system chain of spaceborne radar systems. Today, Synthetic Aperture Radar (SAR) systems are generating images of the Earth's surface with a resolution better than 1 meter. Due to their ability to produce high-resolution radar images independent of sunlight illumination and weather conditions, SAR systems have demonstrated their outstanding capabilities for numerous applications, ranging from environmental and climate monitoring, generation of three-dimensional maps, hazard and disaster monitoring as well as reconnaissance and security related applications. We have entered a new era of spaceborne and airborne SAR systems. New satellite systems like TerraSAR-X and TanDEM-X provide radar images with a resolution cell of more than a hundred times better than the one of conventional SAR systems. The lecture will cover all aspects of spaceborne radar systems including an overview of new technologies, applications and future developments.

Supporting the main lecture, exercise assignments are distributed to the students. The exercise solutions are presented and discussed in detail during lecture hall exercises. Further dedicated topics are explained to deepen the understanding of the main lecture contents.

The aim of the computer-workshop is to gain practical experience on radar systems using data and parameter simulations which are based on the evaluation of simplified models.

Module grade calculation

Reports (answers) that are submitted as part of the SAR calculator workshop (approx. Two weeks after the workshop) can improve the grade.

The grade formation results from the written exam and a grade bonus for the computer workshops.

Note bonuses

Reports (answers) that are submitted as part of the SAR calculator workshop (approx. Two weeks after the workshop) are evaluated and are included in the grade bonuses. The maximum grade is 0.4 grade points, but will only be taken into account when passing exams. The exact value of the grade bonus is calculated in proportion to the evaluated workshop reports. The evaluation of the reports and the award of the bonus performance is carried out by an examiner in the sense of § 18 paragraphs 2 and 3 and is documented in ILIAS.

Annotation

Actual information can be found at the internet page of the IHE (www.ihe.kit.edu).

Workload

Each credit point corresponds to approximately 25-30 hours of work (of the student). This is based on the average student who achieves an average performance. Workload (for a lecture)

Attendance time in lectures, exercises: 60 h

Present study time computer exercise: 40 h

Self-study time including exam preparation: 80 h

A total of 180 h = 6 LP

Recommendation

Signal processing and radar fundamentals.

Literature

Material to the lecture can be found online at www.ihe.kit.edu/VorlesungenSS_892.php or <ftp://sar-lectures@www.microwaves-and-radar.dlr.de> (Password required).

M**6.211 Module: Stochastic Information Processing [M-INFO-100829]****Responsible:** Prof. Dr.-Ing. Uwe Hanebeck**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Control Engineering in Mechatronics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-INFO-101366	Stochastic Information Processing	6 CR	Hanebeck

M**6.212 Module: Student Innovation Lab [M-ETIT-105073]**

Responsible: Prof. Dr.-Ing. Sören Hohmann
 Prof. Dr. Werner Nahm
 Prof. Dr.-Ing. Eric Sax
 Prof. Dr. Wilhelm Stork
 Prof. Dr. Orestis Terzidis
 Prof. Dr.-Ing. Thomas Zwick

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: **Interdisciplinary Subject**

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

Mandatory			
T-ETIT-110291	Innovation Lab	9 CR	Hohmann, Nahm, Sax, Stork, Zwick
T-WIWI-102864	Entrepreneurship	3 CR	Terzidis
T-WIWI-110166	SIL Entrepreneurship Project	3 CR	Terzidis

Competence Certificate

This module consists of an approx. 60-minute written exam on the contents of the Entrepreneurship lectures, as well as 5 other types of exams on the contents of the seminar Entrepreneurship and Innovation Lab in the form of term papers and presentations. All exams results are graded.

In addition, smaller, ungraded term papers are due during the course to monitor progress.

Prerequisites

An application is required to participate in this module. Information about the application: www.kit-student-innovation-lab.de/index.php/for-students/

Competence Goal**Personal competence**

- Reflection faculty:
The students are able to analyze, evaluate and develop an alternative for action for certain elements of action in social interaction
- Decision-making ability:
The students are able to prepare a decision template in time and to provide the necessary arguments for alternative decisions and therefore are able to decide in time.
- Interdisciplinary teamwork
Students are able to detect their limits of competence in one domain and to adjust to a the non-specialist domain. The students are able to detect a lack in competence and to compensate this lack via competences of other team members. The students are able to communicate their domain-specific knowledge and develop a basic understanding of other domains.
- Value-based action:
The students are able to use selected psychological tools to determine their own values. They are able to match these values with team members and reflect if their offer fits these values.

Social competence

- Ability to cooperate:
The students are able to analyze and judge their cooperative behavior in a group.
- Communication competence:
The students are able to present their information in persuasive, focused and target group oriented way.
- Ability to deal with conflicts:
The students are able to detect conflicts in advance, analyze them and name solution concepts.

Innovation and entrepreneurship competence

- Agile product development:
The students are able to apply methods of agile product development e.g. Scrum.
- Methodical innovation retrieval:
The students are able to conduct processes for user- and technology-centered innovation to develop sustainable value propositions for certain target groups (e.g. Design Thinking (DT), Technology Application Selection (TAS)-process).
- Orientation on management of new technology-based firms (NTBF):
The students are able to name central concepts of intellectual property and legal structures. The students are able to name the most important tasks of entrepreneurial leadership. They are able to name the most common form of business modeling and to setup a business plan. The students know important approaches to establish an organization. The students are able to determine the ownership structure in an investment situation. The students are able to name marketing concepts and setup a business model.
- Generate investment readiness:
The students are able to setup rudimentary revenue and cost plan. Furthermore, they are able to establish a project plan for a company in order to derive an investment plan. The students are able to present their business proposal to investors and develop empathy for the investors.
- Competence to develop a business model:
The students are able to apply respective tools for business modeling e.g. Business Model Canvas. The students are able to develop and assess alternative business models.
- Risk handling:
The students are able to name basic risks w.r.t. requirements, technical limitations and profitability. The students are able to apply methods of customer interaction for evaluation of requirements and willingness to pay. The students are able to setup a rudimentary competitors analyze. The students are able to name and identify risks and present potential reactions.

Systemic technical competence

- Problem solution competence:
The students are able to analyze, assess and structurally solve a technical problem.
- Agile methodology of system development:
The students are able to name and apply different system development processes.
- Validation in volatile environment:
The students are able to conduct technical and economical validation under volatile constraints. For this, they are able to name the constraints and interpret the results of the validation.
- Functional decomposition:
The students are able to identify, interpret and derive functional requirements from complex customer needs.
- Architecture development:
The students are able to recognize coherences from the functional requirements and derive a suitable system architecture.

Content

This module strives to combine technical, social and personal competences from the technical and entrepreneurial domain. The objective is to prepare students as best as possible for entrepreneurial activity within or outside of an established organization. Our teaching methods are research-based with a practical orientation.

The lecture Entrepreneurship as the essential component offers the theoretical basis and provides insight in important theoretical concepts and empirical evidence. Currently released case studies and practical experiences of successful founders support the theoretical and empirical content. In order to run a company for the long term additional knowledge is important. That's why the lecture also teaches basic principles for opportunity recognition, business modeling, an introduction to entrepreneurial marketing and leadership. Customer-based design methods from the lean startup approach as well as methods of technology-centered innovation are presented. Future founders have to be able to develop and handle resources such as financial and human capital, infrastructure and intellectual property. Further aspects tackle the establishment of an organization and funding of the own project.

The knowledge taught in the lecture Entrepreneurship will be applied in an application-oriented seminar and the labs. Hence we use an action learning approach to extend the taught knowledge by practical skills and reflection capabilities. In an team of five, the students will experience their way from the ideation process to the final pitch in front of investors.

The students are able to choose between the following options concerning the labs:

- The Automation Innovation Lab offers drones as an innovation platform for cooperative swarm solutions.
- The Industry 4.0 Innovation Lab enables innovation in the context of the next industrial revolution via mobile robot platforms.
- In the Interconnected Intelligent Systems Lab innovations in the context of Assisted Living and Smart Housing are enabled by providing a rich assembly set of mobile robots, actuators and sensors.
- The Computer Vision for Health Lab offers a selection of state-of-the-art imaging devices and powerful computing hardware for innovative image-based applications for medicine and healthcare.

The module also presents methods of agile system development (Scrum) along with associated validation methods as well as methods for functional prototyping. Gate plans are used within the module to determine the progress of the project. Methods for single person work and teamwork are presented and applied. Additionally group-specific knowledge of the different roles of team members, solutions to conflict situations and interdisciplinary teams are presented.

Module grade calculation

The module grade consists of the written exam of the Lecture Entrepreneurship (40%), of the submissions and presentation of the Innovation Lab (40%) and of the submissions and presentation of the SIL Entrepreneurship Project (20%).

Annotation

Related courses:

Lecture Entrepreneurship
Seminar Entrepreneurship Project
Innovation Labs

Please note that the courses must be booked in parallel.

Related exams:

Written exams covering the content of lecture Entrepreneurship
Presentation of the Value Profile (seminar Entrepreneurship)
Submission of the Business Plan (seminar Entrepreneurship)
Submission of a Technical Report with requirements list and system architecture (Innovation Lab)
Submission of the reflection of the Gate Plans (Innovation Lab)
Presentation of the High-fidelity (Innovation Lab)

Workload

Lecture Entrepreneurship: 32h attendance time, 48h preparation and follow-up time, 10h preparation time for assessment

Seminar Entrepreneurship: 34h attendance time, 3h preparation and follow-up time, 53h preparation time for assessment.

Innovation Lab: 8h attendance time, 213h preparation and follow-up time, 49h preparation time for assessment.

This results in a total of 450 hours and a total of 15 LPs for both semesters ($15 \cdot 30 / 2 = 225$).

Recommendation

It is recommended to attend the lecture Entrepreneurship at the same time as the seminar Entrepreneurship Project and the Innovation Lab in the winter semester.

M**6.213 Module: Supplementary Studies on Culture and Society [M-ZAK-106235]**

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: Additional Examinations

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

Election notes

With the exception of the final oral exam and the practice module, students have to self-record the achievements obtained in the Supplementary Studies on Culture and Society in their study plan. 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 ZAK homepage at <https://www.zak.kit.edu/begleitstudium-bak.php>. The title of the examination and the amount of credits override the modules placeholders.

If you want to use ZAK achievements **both for your interdisciplinary qualifications and for the supplementary studies**, please record them in the interdisciplinary qualifications first. You can then get in contact with the ZAK study services (stg@zak.kit.edu) to also record them in your supplementary studies.

In the in-depth module, achievements have to be obtained in three different areas. The areas are as follows:

- Technology & Responsibility
- Doing Culture
- Media & Aesthetics
- Spheres of Life
- Global Cultures

You have to obtain two achievements with 3 credits each and one achievement with 5 credits. To self-record achievements in the in-depth module, you first have to elect the matching partial achievement.

Note: If you registered for the Supplementary Studies on Sustainable Development before April 1st, 2023, self-recording an achievement in this module counts as a request in the sense of §20 (2) of the regulations for the Supplementary Studies on Culture and Society. Your overall grade for the supplementary studies will thus be calculated as the average of the examination grades, not as the average of the module grades.

Mandatory			
T-ZAK-112653	Basics Module - Self Assignment BAK	3 CR	Mielke, Myglas
In-depth Module (Election: 3 items)			
T-ZAK-112654	In-depth Module - Technology & Responsibility - Self Assignment BAK	3 CR	Mielke, Myglas
T-ZAK-112655	In-depth Module - Doing Culture - Self Assignment BAK	3 CR	Mielke, Myglas
T-ZAK-112656	In-depth Module - Media & Aesthetics - Self Assignment BAK	3 CR	Mielke, Myglas
T-ZAK-112657	In-depth Module - Spheres of Life - Self Assignment BAK	3 CR	Mielke, Myglas
T-ZAK-112658	In-depth Module - Global Cultures - Self Assignment BAK	3 CR	Mielke, Myglas
Mandatory			
T-ZAK-112660	Practice Module	4 CR	Mielke, Myglas
T-ZAK-112659	Oral Exam - Supplementary Studies on Culture and Society	4 CR	Mielke, Myglas

Competence Certificate

The monitoring is explained in the respective partial achievement.

They are composed of:

- minutes
- presentations
- a seminar paper
- an internship report
- an oral examination

After successful completion of the supplementary studies, the graduates receive a graded certificate and a KIT certificate.

Prerequisites

The offer is study-accompanying and does not have to be completed within a defined period of time. Enrolment or acceptance for graduation must be present when registering for the final examination.

KIT students register for the supplementary studies by selecting this module in the student portal and self-checking a performance. In addition, registration for the individual courses is necessary, which is possible shortly before the beginning of each semester.

The course catalogue, statutes (study regulations), registration form for the oral exam, and guides for preparing the various written performance requirements can be found as downloads on the ZAK homepage at www.zak.kit.edu/begleitstudium-bak.

Competence Goal

Graduates of the Supplementary Studies on Culture and Society demonstrate a sound basic knowledge of conditions, procedures and concepts for analysing and shaping fundamental social development tasks in connection with cultural topics. They have gained a well-founded theoretical and practical insight into various cultural studies and interdisciplinary topics in the field of tension between culture, technology and society in the sense of an expanded concept of culture.

They are able to place the contents selected from the specialization module in the basic context as well as to analyse and evaluate the contents of the selected courses independently and exemplarily and to communicate about them scientifically in written and oral form. Graduates are able to analyse social topics and problem areas and critically reflect on them in a socially responsible and sustainable perspective.

Content

The Supplementary Studies on Culture and Society can be started from the 1st semester and is not limited in time. It comprises at least 3 semesters. The supplementary studies are divided into 3 modules (basics, in-depth studies, practice). A total of 22 credit points (ECTS) are earned.

The thematic elective areas of the supplementary studies are divided into the following 5 modules and their sub-topics:

Block 1 Technology & Responsibility

Value change / ethics of responsibility, technology development / history of technology, general ecology, sustainability

Block 2 Doing Culture

Cultural studies, cultural management, creative industries, cultural institutions, cultural policy

Block 3 Media & Aesthetics

Media communication, cultural aesthetics

Block 4 Spheres of Life

Cultural sociology, cultural heritage, architecture and urban planning, industrial science

Block 5 Global Cultures

Multiculturalism / interculturalism / transculturalism, science and culture

Module grade calculation

The overall grade of the supplementary studies is calculated as an average of the grades of the examination performances weighted with credit points.

In-depth Module

- presentation 1 (3 ECTS)
- presentation 2 (3 ECTS)
- seminar paper incl. presentation (5 ECTS)
- oral examination (4 ECTS)

Annotation

With the Supplementary Studies on Culture and Society, KIT provides a multidisciplinary study offer as an additional qualification, with which the respective specialized study program is supplemented by interdisciplinary basic knowledge and interdisciplinary orientation knowledge in the field of cultural studies, which is becoming increasingly important for all professions.

Within the framework of the supplementary studies, students acquire in-depth knowledge of various cultural studies and interdisciplinary subject areas in the field of tension between culture, technology and society. In addition to high culture in the classical sense, other cultural practices, common values and norms as well as historical perspectives of cultural developments and influences are considered.

In the courses, conditions, procedures and concepts for the analysis and design of fundamental social development tasks are acquired on the basis of an expanded concept of culture. This includes everything created by humans - also opinions, ideas, religious or other beliefs. The aim is to develop a modern concept of cultural diversity. This includes the cultural dimension of education, science and communication as well as the preservation of cultural heritage. (UNESCO, 1982)

According to § 16 of the statutes, a reference and a certificate are issued by the ZAK for the supplementary studies. The achievements are also shown in the transcript of records of the degree program and, upon request, in the certificate. They can also be recognized in the interdisciplinary qualifications (see elective information).

Workload

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

- basic module approx. 90 h
- in-depth module approx. 340 h
- practical module approx. 120 h

total: approx. 550 h

Learning type

- lectures
- seminars
- workshops
- practical course

Literature

Recommended reading of primary and specialized literature will be determined individually by each instructor.

M**6.214 Module: Supplementary Studies on Sustainable Development [M-ZAK-106099]**

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: Additional Examinations

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

Election notes

With the exception of the final oral exam, students have to self-record the achievements obtained in the Supplementary Studies on Sustainable Development in their study plan. 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 ZAK homepage at <https://www.zak.kit.edu/begleitstudium-bene>. The title of the examination and the amount of credits override the modules placeholders.

If you want to use ZAK achievements **both for your interdisciplinary qualifications and for the supplementary studies**, please record them in the interdisciplinary qualifications first. You can then get in contact with the ZAK study services (stg@zak.kit.edu) to also record them in your supplementary studies.

In the elective module, you need to obtain 6 credits worth of achievements in two of the four areas:

- Sustainable Cities & Neighbourhoods
- Sustainable Assessment of Technology
- Subject, Body, Individual: The Other Side of Sustainability
- Sustainability in Culture, Economy & Society

Usually, two achievements with 3 credits each have to be obtained. To self-record achievements in the elective module, you first have to elect the matching partial achievement.

Note: If you registered for the Supplementary Studies on Sustainable Development before April 1st, 2023, self-recording an achievement in this module counts as a request in the sense of §19 (2) of the regulations for the Supplementary Studies on Sustainable Development. Your overall grade for the supplementary studies will thus be calculated as the average of the examination grades, not as the average of the module grades.

Mandatory			
T-ZAK-112345	Basics Module - Self Assignment BeNe	3 CR	Myglas
Elective Module (Election: at least 6 credits)			
T-ZAK-112347	Elective Module - Sustainable Cities and Neighbourhoods - Self Assignment BeNe	3 CR	
T-ZAK-112348	Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe	3 CR	
T-ZAK-112349	Elective Module - Subject, Body, Individual: the Other Side of Sustainability - Self Assignment BeNe	3 CR	
T-ZAK-112350	Elective Module - Sustainability in Culture, Economy and Society - Self Assignment BeNe	3 CR	
Mandatory			
T-ZAK-112346	Specialisation Module - Self Assignment BeNe	6 CR	Myglas
T-ZAK-112351	Oral Exam - Supplementary Studies on Sustainable Development	4 CR	

Competence Certificate

The monitoring is explained in the respective partial achievement .

They are composed of:

- protocols
- a reflection report
- presentations
- presentations
- the elaboration of a project work
- an individual term paper

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

Prerequisites

The course is offered during the course of study and does not have to be completed within a defined period of time. Enrolment is required for all performance assessments of the modules of 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 self-booking a performance. Registration for courses, performance assessments and examinations is regulated by § 6 of the Statutes and is usually possible shortly before the beginning of the semester.

The course catalogue, statutes (study regulations), registration form for the oral exam and guidelines for preparing the various written performance requirements can be found as downloads on the ZAK homepage at <http://www.zak.kit.edu/begleitstudium-bene>.

Competence Goal

Graduates of the supplementary studies in sustainable development acquire additional practical and professional competencies. Thus, the supplementary study program enables the acquisition of basics and initial experience in project management, trains teamwork skills, presentation skills and self-reflection, and also creates a fundamental understanding of sustainability that is relevant for all professional fields.

Graduates are able to analyse social topics and problem areas and critically reflect on them in a socially responsible and sustainable perspective. They are able to place the contents selected from the modules "Elective" and "Advanced" in the basic context as well as to independently and exemplarily analyse and evaluate the contents of the selected courses and to scientifically communicate about them in written and oral form.

Content

The supplementary study program Sustainable Development can be started from the 1st semester and is not limited in time. The wide range of courses offered by ZAK makes it possible to complete the program usually within three semesters. The supplementary studies comprise 19 credit points (LP). It consists of three modules: Basic Module, Elective Module and Advanced Module.

The thematic elective areas of the supplementary studies are divided into the following 4 modules and their subtopics in Module 2 (elective module):

Block 1 **Sustainable Cities and Neighbourhoods**

The courses provide an overview of the interaction of social, ecological, and economic dynamics in the microcosm of the city.

Block 2 **Sustainability Assessment of Technology**

Mostly based on ongoing research activities, methods and approaches of technology assessment are elaborated.

Block 3 **Subject, Body, Individual: The other Side of Sustainability**

Different approaches are presented to the individual perception, experience, shaping and responsibility of relationships to the environment and to oneself.

Block 4 **Sustainability in Culture, Economy & Society**

Courses usually have an interdisciplinary approach, but may also focus on one of the areas of culture, economics or society, both in application and in theory.

The core of the supplementary studies is a case study in the specialization area. In this project seminar, students conduct sustainability research with practical relevance themselves. The case study is supplemented by an oral examination with two topics from module 2 (elective module) and module 3 (in-depth module).

Module grade calculation

The overall grade of the supplementary studies is calculated as an average of the grades of the examination performances weighted with credit points.

Elective module

- Presentation 1 (3 ECTS)
- Presentation 2 (3 ECTS)

Advanced module

- individual term paper (6 ECTS)
- oral examination (4 ECTS)

Annotation

The Supplementary Studies on Sustainable Development at KIT is based on the conviction that a long-term socially and ecologically compatible coexistence in the global world is only possible if knowledge about necessary changes in science, economy and society is acquired and applied.

The interdisciplinary and transdisciplinary Studies on Sustainable Development enables diverse access to transformation knowledge as well as basic principles and application areas of sustainable development. According to the statutes § 16, a certificate is issued by the ZAK for the complementary studies.

The achievements are also shown in the transcript of records of the degree program and, upon request, in the certificate. They can also be recognized in the interdisciplinary qualifications (see elective information).

In the specialised studies, modules and partial achievements can be recognised within the framework of the additional achievements or e.g. the interdisciplinary qualifications. This must be regulated via the respective subject study programme.

The focus is on experience- and application-oriented knowledge and competences, but theories and methods are also learned. The aim is to be able to represent one's own actions as a student, researcher and later decision-maker as well as an individual and part of society under the aspect of sustainability.

Sustainability is understood as a guiding principle to which economic, scientific, social and individual actions should be oriented. According to this, the long-term and socially just use of natural resources and the material environment for a positive development of global society can only be addressed by means of integrative concepts. Therefore, "education for sustainable development" in the sense of the United Nations programme plays just as central a role as the goal of promoting "cultures of sustainability". For this purpose, practice-centred and research-based learning of sustainability is made possible and the broad concept of culture established at ZAK is used, which understands culture as habitual behaviour, lifestyle and changing context for social actions.

The supplementary study programme conveys the basics of project management, trains teamwork skills, presentation skills and self-reflection. Complementary to the specialised studies at KIT, it creates a fundamental understanding of sustainability, which is important for all professional fields. Integrative concepts and methods are essential: in order to use natural resources in the long term and to shape the global future in a socially just way, not only different disciplines, but also citizens, practitioners and institutions must work together.

Workload

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

- Basic module approx. 180 h
- Elective module approx. 150 h
- Consolidation module approx. 180 h

Total: approx. 510 h

Learning type

- lectures
- seminars
- workshops

Literature

Recommended reading of primary and specialist literature is determined individually by the respective lecturer.

M**6.215 Module: System Integration in Micro- and Nanotechnology [M-MACH-105315]****Responsible:** Dr. Ulrich Gengenbach**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105555	System Integration in Micro- and Nanotechnology	4 CR	Gengenbach

Competence Certificate

A performance assessment is obligatory and can be oral, a written exam, or of another kind.

Prerequisites

None

Competence Goal

The students acquire basic knowledge of challenges and system integration technologies from mechanical engineering, precision engineering and electronics

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
- 3D-Integration in semiconductor technology

Workload

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

Learning type

Lecture

Literature

- Risse, Fertigungsverfahren der Mechatronik, Feinwerk- und Präzisionsgerätetechnik, Vieweg+Teubner Verlag, Wiesbaden, 2012
- Madou, Fundamentals of microfabrication and nanotechnology, CRC Press Boca Raton, 2012
- Habenicht, Kleben Grundlagen, Technologien, Anwendungen, Springer-Verlag Berlin Heidelberg, 2009
- J. Franke, Räumliche elektronische Baugruppen (3D-MID), Carl Hanser-Verlag München, 2013

M**6.216 Module: System Integration in Micro- and Nanotechnology 2 [M-MACH-105316]****Responsible:** Dr. Ulrich Gengenbach**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Microsystems Technology \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)**Credits**
4**Grading scale**
Grade to a tenth**Recurrence**
Each winter term**Duration**
1 term**Language**
German**Level**
4**Version**
1**Election notes**

Attention: The lecture and exam will be offered for the first time in WS20/21!

Mandatory			
T-MACH-110272	System Integration in Micro- and Nanotechnology 2	4 CR	Gengenbach

Competence Certificate

A performance assessment is obligatory and can be oral, a written exam, or of another kind.

Prerequisites

None

Competence Goal

The students acquire knowledge of novel system integration technologies and their application in microoptic and microfluidic systems.

Content

Introduction to system integration (novel processes and applications)

Assembly of hybrid microsystems

Packaging processes

Applications:

- Micro process engineering
- Lab-on-chip systems
- Microoptical systems
- Silicon Photonics

Novel integration processes:

- Direct Laser Writing
- Self Assembly

Workload

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

Learning type

Lecture

Literature

- N.-T. Nguyen, Fundamentals and Applications of Microfluidics, Artech House
- G. T. Reed, Silicon Photonics: An Introduction, Wiley

M**6.217 Module: System-on-Chip Laboratory [M-ETIT-100451]**

Responsible: Prof. Dr.-Ing. Jürgen Becker
Prof. Dr. Ivan Peric

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [Field of Specialization / Field of Specialization: Microsystems Technology \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100798	System-on-Chip Laboratory	6 CR	Becker, Peric

Competence Certificate

Other types of examinations

Prerequisites

none

Competence Goal

Students can reproduce basic knowledge of digital and analog circuit design and hardware-related software programming. In practice, students are able to apply these methods in the following areas using a current system-on-chip architecture:

- Design of a system architecture for mixed-signal systems
- Simulation of the designed digital and analog circuits
- Debugging the implementations at the simulation and implementation level
- Verification of the overall system developed through test benches

In addition, they can apply the hardware / software code design approach and can evaluate implementation targets based on the given requirements (FPGA and ASIC).

Content

In the System-on-Chip Laboratory, a fully-fledged mixed-signal hardware architecture for audio playback based on a system-on-chip (SoC) is developed.

The system design includes the creation of necessary sub-components, their integration into an overall system, and the simulation and verification of the individual components and the overall system. A prototype is implemented and tested on an FPGA basis. The integration is then prepared for a possible ASIC production. Analog circuits are also considered and designed to build an audio amplifier.

Module grade calculation

The grade formation results from the combination of the processing of the exercise sheets, the evaluations during the internship and a final presentation including discussion of the results developed in the project.

Workload

1. Presence time in laboratory appointments: $15 * 4 = 60$ hours
2. Preparation / post-processing: $15 * 4 = 60$ hours
3. Demonstration and integration tests: $3 * 3 = 9$ hours
4. Preparation of the final presentation: 15 hours

Recommendation

- Knowledge of Verilog Hardware Description Language, e.g. from Digital Circuit Design
- Knowledge in the design of analog circuits (amplifier circuits, stability considerations), e.g. from the Analog Circuit Design
- Knowledge of VHDL design, e.g. from Hardware Modeling and Simulation
- Knowledge of simulation of digital circuits, e.g. from Hardware Modeling and Simulation
- Knowledge of hardware design processes and algorithms, e.g. from Hardware Synthesis and Optimisation

M**6.218 Module: Systems and Software Engineering [M-ETIT-100537]****Responsible:** Prof. Dr.-Ing. Eric Sax**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** **Interdisciplinary Subject**

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-ETIT-100675	Systems and Software Engineering	5 CR	Sax

Competence Certificate

Written exam, approx. 120 minutes. (\$4 (2), 1 SPO).

Prerequisites

none

Competence Goal

The students:

- know the most important Life Cycle and process models (including V-Model and agile methods).
- are capable of choosing a suitable method to design and evaluate complex systems.
- know the most important diagram types of hardware and software modeling languages and can design such diagrams from characterization of an application area.
- know the basic methods for quality assurance, which are needed during project development. They know the different test phases of a project and can evaluate the reliability of a system.
- They are familiar with the issues of functional safety and the standards of process evaluation.

Content

Major topics are techniques and methods for the design of complex electric, electronic and electronic programmable systems with software fragments and hardware fragments. The competences of the course comprise comprehensive knowledge and goal-oriented usage of state of the art modeling techniques, development processes, description techniques as well as specification languages.

Module grade calculation

Grades result from the written examination.

Workload

Each credit point (LP, Credit Points) corresponds around 25-30h of work effort of the student. Hereby we assume an average student with average performance. The workload is covered by: 1. Participating in lectures, tutorials and practical labs. 2. Preparing and wrap up of the above named units 3.Exam preparation and presence.

Recommendation

Participation in the lectures Digital System Design (23615) and Information Technology (23622) is advised

M**6.219 Module: Technical Design in Product Development [M-MACH-105318]****Responsible:** Prof. Dr.-Ing. Albert Albers**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105361	Technical Design in Product Development	4 CR	Albers, Matthiesen, Schmid

Competence Certificate

Written examination; duration approx. 1h

Prerequisites

None

Competence Goal

The students:

- acquire and possess sound design skills for use at the interface between engineer and designer.
- master all relevant human-product requirements, such as demographic/geographic and psychographic characteristics, relevant modes of perception, typical recognition contents as well as ergonomic basics.
- have a command of the procedure for designing a product, product range or product system from the structure, through form, colour and graphic design within the phases of the design process.
- have a command of the functional and structural design as well as the important human-machine interface of interface design, have knowledge of the essential parameters of a good corporate design.

Content

Value relevant parameters of the technical design

Basics Interface Design

Macroergonomics: Planning and concept phase

Microergonomics: Concept and design phase

Microergonomics: development phase

Best practice

Module grade calculation

The module grade is composed of:

1. Grade of the written examination (100%)

Annotation

After attending the module, students will have the knowledge of the essential fundamentals of technically oriented design, as an integral part of methodical product development.

Workload

1. Time of presence lecture: 21 h

2. Prepare/follow-up lecture exam preparation: 99 h

Total: 120 h = 4 LP

Learning type**Tutorial.****Media:**

- Beamer
- Models

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

M**6.220 Module: Technical Optics [M-ETIT-100538]**

Responsible: Prof. Dr. Cornelius Neumann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [Interdisciplinary Subject](#)

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

Mandatory			
T-ETIT-100804	Technical Optics	5 CR	Neumann

Prerequisites
 none

M**6.221 Module: Thermal Solar Energy [M-MACH-102388]****Responsible:** Prof. Dr. Robert Stieglitz**Organisation:** KIT Department of Mechanical Engineering

Part of: [Field of Specialization / Field of Specialization: Power Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-MACH-105225	Thermal Solar Energy	4 CR	Stieglitz

Competence Certificate

A performance assessment is obligatory; oral exam about 30 minutes

Prerequisites

none

Competence Goal

Based on the elaboration of the basic physics knowledge of the solar irradiation, heat radiation, optics and thermal-hydraulics, the student will be able to

- select solar thermal components such as mirrors, glasses, selective absorbers and insulation materials and their manufacturing processes and to calculate and assess their performance,
- identify different collector types and to indicate their potential field of application,
- characterize the entire solar thermal collector system with respect to its performance and derive from the collector characteristics its suitability for different types of use,
- embed collectors into a technical overall system for heat (household, process heat, heat storage networks) or electricity generation (power plant), to calculate the system efficiency and independently develop the basics of its optimization.
- identify adequate thermal storage types for the temporal separation of generation and consumption, to dimension them appropriately and to integrate them into a system concept,
- evaluate solar thermal systems in their entirety (capacity, estimation of system dynamics, response behavior, efficiency) and know options for integration into networks (heat, cold, electricity).

Content

Fundamentals of thermal solar energy from solar irradiation (influence of time and place, modifications in the atmosphere) and their implementation in a collector to integration into a technical overall system. In detail:

1. *introduction* to the energy demand and evaluation of the application potential of solar thermal energy.
2. *primary energy source SUN*: Sun, solar constant, solar radiation (scattering, absorption in the atmosphere, direct-diffuse radiation, angular influences, radiation balance).
3. *solar collectors*: basic design of a collector, basics of determining the efficiency, significance of concentration and its limitations, solar thermal collector types (designs, efficiency, system technology).
4. *passive mechanisms of solar thermal energy*: heat conduction in solids and gases, radiation heat transport in transparent and opaque bodies Design requirements and physical principles of solar thermal glasses, mirrors and selective absorbers. Goal oriented selection of materials and manufacturing processes.
5. *momentum and heat transport*: basic equations of single- and multi-phase transport, basic ideas of local and system engineering calculation methods, stability limits.

Optional

6. *solar thermal low-temperature systems*: collector variants, methods for system simulation, planning and dimensioning of systems, system-related system design and stagnation scenarios and their handling.
7. *solar thermal high-temperature systems*: solar thermal power plants (classification of system components, loss mechanisms, upwind power plants), coupling of collector with energy generation process.

At the end:

8. *Thermal energy storage*: Explanation of terms (energy contents, storage forms and materials, potentials ...), storage concepts (system structure, design ratio), system integration.
9. *Solar air conditioning*: Determination of cooling capacity, indoor climate, solar cooling methods and evaluation of air conditioning.

Workload

regular lecture attendance: 30 h

self-study: 60 h (incl. supplementary searches)

exam preparation 30 h

Recommendation

desirable are reliable knowledge in physics in optics and thermodynamics

Basics in heat and mass transfer, material science, energy technology and fluid mechanics

Learning type

Präsentation complemented by printouts

Literature

supply of lecture material in printed and electronic form

Stieglitz & Heinzel; Thermische Solarenergie -Grundlagen-Technologie- Anwendungen. Springer Vieweg Verlag. 711 Seiten. ISBN 978-3-642-29474-7

M**6.222 Module: Ubiquitous Computing [M-INFO-100789]****Responsible:** Prof. Dr.-Ing. Michael Beigl**Organisation:** KIT Department of Informatics**Part of:** [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)

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

Mandatory			
T-INFO-101326	Ubiquitous Computing	5 CR	Beigl

M**6.223 Module: Ultrasound Imaging [M-ETIT-100560]****Responsible:** Dr. Nicole Ruiter**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Field of Specialization](#) / [Field of Specialization: Medical Technology \(Complementary Modules\)](#)**Credits**
3**Grading scale**
Grade to a tenth**Recurrence**
Each summer term**Duration**
1 term**Language**
German**Level**
4**Version**
1**Mandatory**

T-ETIT-100822	Ultrasound Imaging	3 CR	Ruiter
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Prerequisites

none

M**6.224 Module: Vehicle Lightweight Design - Strategies, Concepts, Materials [M-MACH-102703]****Responsible:** Prof. Dr.-Ing. Frank Henning**Organisation:** KIT Department of Mechanical Engineering

Lightweight Design

Part of: [Field of Specialization / Field of Specialization: Automotive Engineering \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning

Competence Certificate

Written exam; Duration approx. 90 min

Prerequisites

none

Competence Goal

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.

ContentStrategies 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

metallic materials

Steel, aluminium, magnesium, titan

Workload

1. Attendance of lectures: 21 h

2. Preparation and attendance of examination: 99 h

Total: 120 h = 4 LP

Learning type

Lecture

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.

M**6.225 Module: Virtual Engineering 1 [M-MACH-105293]****Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova**Organisation:****Part of:** **Interdisciplinary Subject**
Additional Examinations

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

Mandatory			
T-MACH-102123	Virtual Engineering I	4 CR	Ovtcharova

Competence Certificate

Written exam, graded, 90 min.

Competence Goal

After successful attendance of the course, students can:

- conceptualize complex systems with the methods of virtual engineering and continue the product development in different domains
- model the digital product with regard to planning, design, manufacturing, assembly and maintenance.
- use validation systems to validate product and production in an exemplary manner.
- Describe AI methods along the product creation process.

Content

- Conception of the product (system approaches, requirements, definitions, structure)
- Generation of domain-specific product data (CAD, ECAD, software, ...) and AI methods
- Validation of product properties and production processes through simulation
- Digital twin for optimization of products and processes using AI methods

Module grade calculation

Examination result "Virtual Engineering 1" 100%

Workload

120 h

Recommendation

None

Learning type

Lecture and exercises

Literature

Lecture slides

M**6.226 Module: Virtual Engineering A [M-MACH-101283]****Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
9	Grade to a tenth	Each term	2 terms	German	4	6

Mandatory			
T-MACH-102123	Virtual Engineering I	4 CR	Ovtcharova
Virtual Engineering A (Election: at least 5 credits)			
T-MACH-102185	CATIA CAD Training Course	2 CR	Ovtcharova
T-MACH-105312	CATIA Advanced	4 CR	Ovtcharova
T-MACH-102209	Information Engineering	3 CR	Ovtcharova
T-MACH-106743	IoT Platform for Engineering	4 CR	Ovtcharova
T-MACH-102181	PLM for Product Development in Mechatronics	4 CR	Eigner
T-MACH-106740	Virtual Engineering Lab	4 CR	Ovtcharova
T-MACH-106741	Virtual Training Factory 4.X	4 CR	Ovtcharova
T-MACH-111285	Virtual Solution Methods and Processes	4 CR	Maier, Ovtcharova

Competence Certificate

The assessment is carried out as partial exams (according to Section 4 (2), 1-3 SPO) of the core course and further 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.

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 students should:

- have basic knowledge about the industrial application of Information Technology in product development,
- have understanding about current and future application of information systems in product development processes in the context of Product Lifecycle Management and Virtual Engineering,
- be able to operate current CAx- and PLM-systems in the product development process
- understands demands and relevance of interconnected IT-systems and respective methods for product development

Content

The Module Virtual Engineering A gives an overview about product development processes, beginning with requirement engineering, verification of manufacturing feasibility and virtual operation in the scope of Digital Factory. The guest-lectures contained in this module complete the content of the lecture with introducing current product development processes focusing.

Workload

- regular attendance: 140 hours
- Preparation and reworking: 20 hours
- Exam and exam revision/preparation: 110 hours

Learning type

Lecture, exercise

M**6.227 Module: Virtual Engineering Lab [M-MACH-105475]****Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Field of Specialization / Field of Specialization: Design of Mechatronic Systems \(Internships\)](#)
[Interdisciplinary Subject](#)

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

Mandatory			
T-MACH-106740	Virtual Engineering Lab	4 CR	Ovtcharova

Competence Certificate

Alternative exam assessment.

Prerequisites

None

Competence Goal

Students are able to design and implement a complex task in teamwork using VR/MR/AR hardware and software.

Content

VR/AR/MR basics (hardware, software), tools and applications

Module grade calculation

Alternative exam assessment.

Workload

120 hours

Learning type

Project work in the team

M**6.228 Module: Wearable Robotic Technologies [M-INFO-103294]**

Responsible: Prof. Dr.-Ing. Tamim Asfour
Prof. Dr.-Ing. Michael Beigl

Organisation: KIT Department of Informatics

Part of: [Field of Specialization / Field of Specialization: Medical Technology \(Complementary Modules\)](#)
[Field of Specialization / Field of Specialization: Robotics \(Complementary Modules\)](#)
[Interdisciplinary Subject](#)
[Additional Examinations](#)

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

Mandatory			
T-INFO-106557	Wearable Robotic Technologies	4 CR	Asfour, Beigl

Competence Certificate

See partial achievements (Teilleistung)

Prerequisites

See partial achievements (Teilleistung)

Competence Goal

The student has received fundamental knowledge about wearable robotic technologies and understands the requirements for the design, the interface to the human body and the control of wearable robots. He/she is able to describe methods for modelling the human neuromusculoskeletal system, the mechatronic design, fabrication and composition of interfaces to the human body. The student understands the symbiotic human-machine interaction as a core topic of Anthropomatics and has knowledge of state-of-the-art examples of exoskeletons, orthoses and prostheses.

Content

The lecture provides an overview of wearable robot technologies (exoskeletons, prostheses and orthoses) and their potentials. It starts with the basics of wearable robotics and introduces different approaches to the design of wearable robots and their related actuator and sensor technology. The lecture focuses on modeling the neuromusculoskeletal system of the human body, the interfaces of wearable robots to the human body and the physical and cognitive human-robot interaction for tightly-coupled hybrid human-robot systems. Examples of current research and various applications of lower, upper and full body exoskeletons as well as prostheses are presented.

Workload

Lecture with 2 SWS, 4 LP

4 LP corresponds to 120 hours, including

15 * 2 = 30 hours attendance time

15 * 3 = 45 self-study

45 hours preparation for the exam

Recommendation

Attending the lecture Mechano-Informatics and Robotics is recommended.

7 Courses

T

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

Responsible: Prof. Dr. Manfred Kohl

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-102698 - Actuators and Sensors in Nanotechnology](#)


Type
Oral examination




Credits
4

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events					
WT 22/23	2141866	Actuators and sensors in nanotechnology	2 SWS	Lecture / 	Kohl, Sommer

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

Competence Certificate

oral exam

Prerequisites


none





T

7.2 Course: Advanced Artificial Intelligence [T-INFO-112768]

Responsible: Prof. Dr. Jan Niehues
Organisation: KIT Department of Informatics
Part of: [M-INFO-106299 - Advanced Artificial Intelligence](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1



Events					
ST 2023	2400141	Advanced Artificial Intelligence	4 SWS	Lecture / 	Waibel, Niehues, Asfour





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

T

7.3 Course: Analog Circuit Design [T-ETIT-100973]

Responsible: Prof. Dr. Ivan Peric**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100466 - Analog Circuit Design](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1

Events					
WT 22/23	2312664	Analog Circuit Design	2 SWS	Lecture / 	Peric
WT 22/23	2312666	Tutorial for 2312664 Analog Circuit Design	1 SWS	Practice / 	Peric

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

T

7.4 Course: Antennas and Multiple Antenna Systems [T-ETIT-106491]

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100565 - Antennas and Multiple Antenna Systems](#)

Type
Oral examination

Credits
5

Grading scale
Grade to a third

Recurrence
Each winter term

Version
4

Events					
WT 22/23	2308416	Antennas and Multiple Antenna Systems	2 SWS	Lecture / 🗣️	Zwick
WT 22/23	2308417	Workshop for 2308416 Antennas and Multiple Antenna Systems	2 SWS	Practice / 🧩	Zwick, Kretschmann, Bekker

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

Competence Certificate

The success control takes place within the framework of an oral overall examination (20 minutes).



Prerequisites





T-ETIT-100638 - Antennen und Mehrantennensysteme wurde weder begonnen, noch abgeschlossen.

Das Modul "Antennen und Antennensysteme" darf nicht begonnen oder abgeschlossen sein.

T

7.5 Course: Appliance and Power Tool Design [T-MACH-105229]**Responsible:** Prof. Dr.-Ing. Sven Matthiesen**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-102705 - Appliance and Power Tool Design](#)**Type**
Oral examination**Credits**
2**Grading scale**
Grade to a third**Recurrence**
Each summer term**Version**
2

Events					
ST 2023	2145164	Appliance and Power Tool Design	3 SWS	Lecture / 	Matthiesen
ST 2023	2145165	Appliance and Power Tool Design Project Work	3 SWS	Project (P / 	Matthiesen, Mitarbeiter

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

Oral examination (20 min)

Prerequisites

The participation in “Appliance and power tool design” requires the concurrent project work.

Due to organizational reasons, the number of participants is limited. At the beginning of August, a registration form will be available at the IPEK website. In the case of too many applicants, a selection process will be taking place. An early application is advantageous.

Modeled Conditions

The following conditions have to be fulfilled:


1. The course [T-MACH-110767 - Appliance and Power Tool Design Project Work](#) must have been started.





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7.6 Course: Appliance and Power Tool Design Project Work [T-MACH-110767]

Responsible: Prof. Dr.-Ing. Sven Matthiesen
Organisation: KIT Department of Mechanical Engineering
Part of: [M-MACH-102705 - Appliance and Power Tool Design](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	6	Grade to a third	Each summer term	1 terms	1

Events					
ST 2023	2145165	Appliance and Power Tool Design Project Work	3 SWS	Project (P / )	Matthiesen, Mitarbeiter

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

Annotation



The participation in the project work requires the participation in “Appliance and power tool design”.





Due to organizational reasons, the number of participants is limited. At the beginning of august, a registration form will be available at the IPEK website. In the case of too many applicants, a selection process will be taking place. An early application is advantageous

T

7.7 Course: Applied Information Theory [T-ETIT-100748]

Responsible: Dr.-Ing. Holger Jäkel**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100444 - Applied Information Theory](#)**Type**
Oral examination**Credits**
6**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1

Events					
WT 22/23	2310537	Applied Information Theory	3 SWS	Lecture / 	Jäkel
WT 22/23	2310539	Tutorial for 2310537 Applied Information Theory	1 SWS	Practice / 	Jäkel

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


none





T

7.8 Course: Artificial Intelligence in Production [T-MACH-112115]

Responsible: Prof. Dr.-Ing. Jürgen Fleischer**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105968 - Artificial Intelligence in Production](#)

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

Events					
WT 22/23	2149921	Artificial Intelligence in Production	2 SWS	Lecture / 	Fleischer, Schlagenhauf

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

Written Exam (90 min)

Prerequisites

none

T

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

Responsible: Prof. Dr.-Ing. Jürgen Fleischer**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105108 - Automated Manufacturing Systems](#)**Type**
Oral examination**Credits**
8**Grading scale**
Grade to a third**Recurrence**
Each summer term**Version**
1

Events					
ST 2023	2150904	Automated Manufacturing Systems	6 SWS	Lecture / Practice (/ ●)	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.

Modeled Conditions

The following conditions have to be fulfilled:


1. The course [T-MACH-102162 - Automated Manufacturing Systems](#) must not have been started.





T

7.10 Course: Automated Visual Inspection and Image Processing [T-INFO-101363]

Responsible: Prof. Dr.-Ing. Jürgen Beyerer
Organisation: KIT Department of Informatics
Part of: [M-INFO-100826 - Automated Visual Inspection and Image Processing](#)

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

Events					
WT 22/23	24169	Automated Visual Inspection and Image Processing	4 SWS	Lecture / 	Beyerer, Zander, Fischer

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

T

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





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

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-100501 - Automotive Engineering I](#)

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

Events					
WT 22/23	2113805	Automotive Engineering I	4 SWS	Lecture / 	Gauterin, Unrau
WT 22/23	2113809	Automotive Engineering I	4 SWS	Lecture / 	Gauterin, Gießler

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

Competence Certificate

Written examination

Duration: 120 minutes

Auxiliary means: none

Prerequisites

Only one out of the two modules "M-MACH-100501 - Grundlagen der Fahrzeugtechnik I" and "M-MACH-102686 - Automotive Engineerin I" is allowed

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-102203 - Automotive Engineering I](#) must not have been started.

T



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

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

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-100502 - Automotive Engineering II](#)

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

Events					
ST 2023	2114835	Automotive Engineering II	2 SWS	Lecture / 	Unrau
ST 2023	2114855	Automotive Engineering II	2 SWS	Lecture / 	Gießler

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

Competence Certificate

Written Examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites

none

T


7.13 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-102693 - Automotive Vision](#)

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

Events					
ST 2023	2138340	Automotive Vision	3 SWS	Lecture / 	Lauer

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

Competence Certificate

Type of Examination: written exam

Duration of Examination: 60 minutes

Prerequisites

none

T

7.14 Course: Basics Module - Self Assignment BAK [T-ZAK-112653]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: [M-ZAK-106235 - Supplementary Studies on Culture and Society](#)

Type	Credits	Grading scale	Version
Completed coursework	3	pass/fail	1

Competence Certificate

The monitoring in this module includes a course credit according to § 5 section 4 in the form of minutes of which two are to be handed in freely chosen topics of the lecture series " Introduction to Applied Studies on Culture and Society ". Length: approx. 6,000 characters each (incl. spaces).

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation

Fjordevik, Anneli und Jörg Roche: Angewandte Kulturwissenschaften. Vol. 10. Narr Francke Attempto Verlag, 2019.

Annotation

The Basic Module consists of the lecture "Introduction to Supplementary Studies on Culture and Society", which is offered only in the winter semester. It is therefore recommended that students start their studies in the winter semester and complete them before module 2.

T

7.15 Course: Basics Module - Self Assignment BeNe [T-ZAK-112345]**Responsible:** Christine Myglas**Organisation:****Part of:** [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

Type	Credits	Grading scale	Version
Completed coursework	3	pass/fail	1

Competence Certificate

The monitoring in this module includes a course credit according to § 5 section 4:

[Introduction to Sustainable Development](#) in the form of minutes of which two are to be handed in freely chosen topics of the lecture series "Introduction to Sustainable Development". Length: approx. 6,000 characters each (incl. spaces).

or

[Sustainability Spring Days at KIT](#) in the form of a reflection report on all components of the project days "Sustainability Spring Days at KIT". Length approx. 12,000 characters (incl. spaces).

Prerequisites

None

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation

Kropp, Ariane: Grundlagen der Nachhaltigen Entwicklung: Handlungsmöglichkeiten und Strategien zur Umsetzung. Springer-Verlag, 2018.

Pufé, Iris: Nachhaltigkeit. 3. überarb. Edition, UTB, 2017.

Roorda, Niko, et al.: Grundlagen der nachhaltigen Entwicklung. Springer-Verlag, 2021.

Annotation

Module Basics consists of the lecture " Introduction to Sustainable Development ", which is only offered in the summer semester or alternatively of the project days " Sustainability Spring Days at KIT ", which is only offered in the winter semester. It is recommended to complete the course before Elective Module and Specialisation Module.

In exceptional cases, Elective Module or Specialisation Module can also be completed simultaneously with Basics Module. However, the prior completion of the advanced modules Elective and Specialisation should be avoided.

T


7.16 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-105283 - Basics of Technical Logistics I](#)

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

Events					
WT 22/23	2117095	Basics of Technical Logistics I	3 SWS	Lecture / Practice (/ )	Mittwollen, Oellerich

Legend:  Online,  Blended (On-Site/Online),  On-Site, X 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 preconditioned.

T

7.17 Course: Basics of Technical Logistics II [T-MACH-109920]**Responsible:** Dr.-Ing. Maximilian Hochstein**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105302 - Basics of Technical Logistics II](#)

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

Events					
WT 22/23	2117098	Basics of Technical Logistics II	3 SWS	Lecture / Practice (/ )	Oellerich

Legend:  Online,  Blended (On-Site/Online),  On-Site, X 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 Logistics I" (T-MACH-109919) preconditioned.





T

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

Responsible: Prof. Dr.-Ing. Ulrike Krewer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100532 - Batteries and Fuel Cells](#)

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

Events					
WT 22/23	2304207	Batteries and Fuel Cells	2 SWS	Lecture / 	Krewer
WT 22/23	2304213	Batteries and Fuel Cells (Exercise to 2304207)	1 SWS	Practice / 	Krewer, Lindner

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

Prerequisites


none





T

7.19 Course: Batteries and Fuel Cells Laboratory [T-ETIT-100708]

Responsible: Dr.-Ing. Andre Weber**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100381 - Batteries and Fuel Cells Laboratory](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each winter term	1

Events					
WT 22/23	2304235	Batteries and Fuel Cells Laboratory	4 SWS	Practical course / 	Weber

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



7.20 Course: Battery and Fuel Cells Systems [T-ETIT-100704]

Responsible: Dr.-Ing. Andre Weber

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-100377 - Battery and Fuel Cells Systems](#)

Type
Oral examination

Credits
3

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events					
ST 2023	2304214	Batterie- und Brennstoffzellensysteme	2 SWS	Lecture /	Weber


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





T

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

Responsible: Dr.-Ing. Axel Loewe
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100549 - Bioelectric Signals](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	2

Events					
ST 2023	2305264	Bioelectric Signals	2 SWS	Lecture / 	Loewe

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

Competence Certificate

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

Prerequisites

none

T

7.22 Course: Biologically Inspired Robots [T-INFO-101351]

Responsible: Dr.-Ing. Arne Rönnau
Organisation: KIT Department of Informatics
Part of: [M-INFO-100814 - Biologically Inspired Robots](#)

Type
Oral examination

Credits
3





Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events

ST 2023	24619	Biologisch Motivierte Roboter	2 SWS	Lecture / 	Rönnau
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled





T

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

Responsible: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100387 - Biomedical Measurement Techniques I](#)

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

Events					
WT 22/23	2305269	Biomedical Measurement Techniques I	2 SWS	Lecture / 	Nahm, Schaufelberger

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

Prerequisites

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





T

7.24 Course: Biomedical Measurement Techniques II [T-ETIT-106973]

Responsible: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100388 - Biomedical Measurement Techniques II](#)

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

Events					
ST 2023	2305270	Biomedical Measurement Techniques II	2 SWS	Lecture / 	Nahm

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

Competence Certificate

Success is checked in the form of a written test of 60 minutes. The module grade is the grade of the written exam. Bonus points can also be awarded. You can find information on this under "Module grade".

Prerequisites

The successful participation in the module Biomedical Measurement Techniques I is a prerequisite.

Recommendation

Basics in physiology. Basics in physical measurement technology, good previous knowledge of analog circuit technology and in digital signal processing.

Annotation

The event is based on an interactive combination of lecture parts and seminar parts. In the seminar part, the participants are asked to independently prepare and present individual topics of the course in small groups. These contributions are evaluated and the students receive bonus points for this. The bonus points are added to the points achieved in the written exam. The sum of the points gives the module grade.

T

7.25 Course: BioMEMS - Microfluidic Chipsystems V [T-MACH-111069]




Responsible: Prof. Dr. Andreas Guber
Dr. Taleieh Rajabi

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-105484 - BioMEMS - Microfluidic Chipsystems V](#)

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

Events					
WT 22/23	2141103	BioMEMS V - Microfluidic Chip Systems	2 SWS	Lecture / 	Rajabi, Guber

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

Competence Certificate

oral exam (appr. 20 Min.)

Prerequisites

none

T


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





Responsible: Prof. Dr. Andreas Guber

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-100489 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine I](#)

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

Events					
WT 22/23	2141864	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	2 SWS	Lecture / 	Guber, Ahrens

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

Competence Certificate

written exam (75 Min.)

Prerequisites

none

T

7.27 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II [T-MACH-100967]**Responsible:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-100490 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine II](#)

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

Competence Certificate

Written exam (75 Min.)

Prerequisites

none

T**7.28 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III [T-MACH-100968]**

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

Part of: [M-MACH-100491 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine III](#)

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

Competence Certificate

Written exam (75 Min.)

Prerequisites

none

T

7.29 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine IV [T-MACH-106877]

Responsible: Prof. Dr. Andreas Guber

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-105483 - BioMEMS - Microsystemtechnology for Life-Science and Medicine IV](#)

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

Events					
WT 22/23	2141102	BioMEMS IV - Microsystems technology for Life Sciences and Medicine	2 SWS	Lecture	Guber, Ahrens, Doll, Länge

Competence Certificate

Oral examination (45 Min.)

Prerequisites

none

T

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





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

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-105286 - BUS-Controls](#)

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

Events					
ST 2023	2114080	Control of Mobile Machines	2 SWS	Lecture / 	Geimer, Becker

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.

Prerequisites

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

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-108889 - BUS-Controls - Advance](#) must have been passed.

Recommendation

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

The number of participants is limited. A registration 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.

Annotation

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

After the practical oriented lessons the students will be able to visualize the communication structure of different applications, design basic systems and evaluate the complexity of programming of the complete system.

Hereunto the students program in the practical orientated lessons IFM-controllers using the programming environment CoDeSys.

Content:

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

Literature:

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

T

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

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

Part of: [M-MACH-105286 - BUS-Controls](#)

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

Competence Certificate
Creation of control program

Prerequisites
none

T



7.32 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-102684 - CAE-Workshop](#)

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

Events					
WT 22/23	2147175	CAE-Workshop	3 SWS	Block / 	Albers, Mitarbeiter
ST 2023	2147175	CAE-Workshop	3 SWS	Block / 	Albers, Mitarbeiter

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



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

T

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

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova**Organisation:** KIT Department of Mechanical Engineering**Part of:** M-MACH-101283 - Virtual Engineering A

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each term	1

Events					
WT 22/23	2123380	Advanced CATIA	3 SWS	Project (P / )	Ovtcharova, Mitarbeiter
ST 2023	2123380	CATIA advanced	3 SWS	Project (P / )	Ovtcharova, Mitarbeiter

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

Competence Certificate

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

Prerequisites

none

T

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

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

Part of: M-MACH-101283 - Virtual Engineering A

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

Events					
WT 22/23	2123358	CATIA CAD training course	2 SWS	Practical course / ✿	Ovtcharova, Mitarbeiter
ST 2023	2123358	CATIA CAD training course	2 SWS	Practical course / ✿	Ovtcharova, Mitarbeiter

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.

T**7.35 Course: Channel Coding: Algebraic Methods for Communications and Storage [T-ETIT-111244]****Responsible:** Prof. Dr.-Ing. Laurent Schmalen**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-105616 – Channel Coding: Algebraic Methods for Communications and Storage](#)

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

Events					
ST 2023	2310546	Channel Coding: Algebraic Methods for Communications and Storage	2 SWS	Lecture / 	Schmalen

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

The exam is held as an oral exam of 20 Min according to 4 Abs. 2 Nr. 1 SPO Bachelor/Master Elektrotechnik und Informationstechnik. Grade of the module corresponds to the grade of the oral exam.

Prerequisites

none

Recommendation

Previous attendance of the lectures "Communication Engineering I" and "Probability Theory" is recommended.

T



7.36 Course: Communication Systems and Protocols [T-ETIT-101938]




Responsible: Dr.-Ing. Jens Becker
Prof. Dr.-Ing. Jürgen Becker

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-100539 - Communication Systems and Protocols](#)

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

Events					
ST 2023	2311616	Communication Systems and Protocols	2 SWS	Lecture / 	Becker, Becker
ST 2023	2311618	Tutorial for 2311616 Communication Systems and Protocols	1 SWS	Practice / 	Stammler

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

Prerequisites

none

T





7.37 Course: Communications Engineering II [T-ETIT-110697]





Responsible: Dr.-Ing. Holger Jäkel
Prof. Dr.-Ing. Laurent Schmalen

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-105274 - Communications Engineering II](#)

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

Events					
WT 22/23	2310509	Communications Engineering II	2 SWS	Lecture / 	Jäkel
WT 22/23	2310510	Übung zu 2310509 Communications Engineering II	1 SWS	Practice / 	Jäkel
ST 2023	2310511	Communications Engineering II	2 SWS	Lecture / 	Jäkel
ST 2023	2310513	Tutorial for 2310511 Communications Engineering II	1 SWS	Practice / 	Sturm

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

Competence Certificate

The assessment will be carried out in the form of a written exam of 120 minutes. The module grade is the grade of the written exam.

Prerequisites

none

Recommendation

Knowledge of basic engineering mathematics including integral transformations and probability theory as well as basic knowledge of communications engineering.

Previous visit to the lecture "Communications Engineering I", "Probability Theory" and "Signals and Systems" is recommended.

T

7.38 Course: Communications Engineering Laboratory [T-ETIT-100746]

Responsible: Dr.-Ing. Holger Jäkel**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100442 - Communications Engineering Laboratory](#)**Type**
Oral examination**Credits**
6**Grading scale**
Grade to a third**Recurrence**
Each term**Version**
1

Events					
WT 22/23	2310517	Communication Engineering Laboratory	4 SWS	Practical course / 🔄	Schmalen, Jäkel, Sturm, Edelmann
ST 2023	2310517	Communication Engineering Laboratory	4 SWS	Practical course / 🔄	Schmalen, Jäkel, Edelmann, Sturm

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

Prerequisites

none


T**7.39 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

Lightweight Design

Part of: [M-ETIT-102734 - Materials](#)

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

Events					
ST 2023	2114053	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	2 SWS	Lecture / 	Henning

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

Competence Certificate

written exam 90 minutes

Prerequisites

none

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-100531 - Systematic Materials Selection](#) must not have been started.

T

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





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

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-105296 - Computational Intelligence](#)

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

Events					
WT 22/23	2105016	Computational Intelligence	2 SWS	Lecture / 	Mikut, Reischl

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

Competence Certificate

Written exam (Duration: 1h)

Prerequisites

none

T


7.41 Course: Continuum Mechanics of Solids and Fluids [T-MACH-110377]





Responsible: Prof. Dr.-Ing. Thomas Böhlke
Prof. Dr.-Ing. Bettina Frohnäpfel

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-105180 - Continuum Mechanics](#)

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

Events					
WT 22/23	2161252	Continuum mechanics of solids and fluids	2 SWS	Lecture / 	Böhlke, Frohnäpfel

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

Competence Certificate

Written examination (90 min). Additives as announced

Prerequisites

passing the corresponding "Tutorial Continuum Mechanics of Solids and Fluids" (T-MACH-110333)

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-110333 - Tutorial Continuum Mechanics of Solids and Fluids](#) must have been passed.

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.

T

7.42 Course: Control of Linear Multivariable Systems [T-ETIT-100666]**Responsible:** Dr.-Ing. Mathias Kluwe**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100374 - Control of Linear Multivariable Systems](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 22/23	2303177	Control of Linear Multivariable Systems	3 SWS	Lecture / 	Kluwe
WT 22/23	2303179	Control of Linear Multivariable Systems (Tutorial to 2303177)	1 SWS	Practice / 	N.N.

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

Success is checked as part of a written overall test (120 minutes) of the course.

Prerequisites

none

Recommendation

For a deeper understanding, basic knowledge of system dynamics and control technology is absolutely necessary, as taught in the ETIT Bachelor module "System Dynamics and Control Technology" M-ETIT-102181.

T

7.43 Course: Control of Power-Electronic Systems [T-ETIT-111897]



Responsible: Dr.-Ing. Andreas Liske**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-105915 - Control of Power-Electronic Systems](#)





Type
Oral examination

Credits
6

Grading scale
Grade to a third

Version
1

Events					
ST 2023	2306337	Control of Power-Electronic Systems	3 SWS	Lecture / 	Liske, Schmitz-Rode
ST 2023	2306338	Tutorial for 2306337 Control of Power-Electronic Systems	1 SWS	Practice / 	Liske, Schmitz-Rode


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





T

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

Responsible: Hon.-Prof. Dr. Christoph Gönninger**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105348 - Control Technology](#)

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

Events					
ST 2023	2150683	Control Technology	2 SWS	Lecture / 	Gönninger

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

Written Exam (60 min)

Prerequisites

none



7.45 Course: Control Theory Laboratory [T-ETIT-111009]

Responsible: Prof. Dr.-Ing. Sören Hohmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-105467 - Control Theory Laboratory](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	6	Grade to a third	Each term	1 terms	1

Events					
WT 22/23	2303169	Control Theory Laboratory	4 SWS	Block /	Hohmann

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

Prerequisites


none





T

7.46 Course: Current Topics on BioMEMS [T-MACH-102176]

Responsible: Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105485 - Current Topics on BioMEMS](#)

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

Events					
WT 22/23	2143873	Actual topics of BioMEMS	2 SWS	Seminar / 	Guber, Ahrens

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

active participation and own presentation (30 Min.)

Prerequisites

none



7.47 Course: Cyber Physical Production Systems [T-ETIT-112223]

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-106039 - Cyber Physical Production Systems](#)

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

Events					
ST 2023	2303301	Cyber Physical Production Systems	2 SWS	Lecture /	Barth

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

Competence Certificate

The examination takes place within the framework of an oral overall examination (20 minutes).

The module grade is the grade of the oral exam.

Prerequisites

none

T

7.48 Course: Decentrally Controlled Intralogistic Systems [T-MACH-105230]

Responsible: Prof. Dr.-Ing. Kai Furmans
Dr.-Ing. Maximilian Hochstein

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-102687 - Decentrally Controlled Intralogistic Systems](#)



Type
Completed coursework





Credits
4

Grading scale
pass/fail

Recurrence
Each term

Version
3

Events					
WT 22/23	2117084	Decentrally controlled intralogistic systems	2 SWS	Practical course / 	Furmans, Sperling, Arndt
ST 2023	2117084	Decentrally controlled intralogistic systems	2 SWS	Practical course / 	Furmans, Sperling, Arndt

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

Competence Certificate

Certificate by colloquium with presentation

Prerequisites





None

T**7.49 Course: Deep Learning and Neural Networks [T-INFO-109124]**

Responsible: Prof. Dr. Alexander Waibel
Organisation: KIT Department of Informatics
Part of: [M-INFO-104460 - Deep Learning and Neural Networks](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1

Events					
ST 2023	2400024	Deep Learning and Neural Networks	4 SWS	Lecture / 	Waibel

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

T

7.50 Course: Deep Learning for Computer Vision I: Basics [T-INFO-111491]

Responsible: Prof. Dr.-Ing. Rainer Stiefelhagen
Organisation: KIT Department of Informatics
Part of: [M-INFO-105753 - Deep Learning for Computer Vision I: Basics](#)

Type
Oral examination





Credits
3

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events					
ST 2023	2400007	Deep Learning for Computer Vision I: Basics	2 SWS	Lecture / 	Stiefelhagen, Roitberg

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

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-INFO-109796 - Deep Learning for Computer Vision](#) must not have been started.

Recommendation

Basic knowledge of pattern recognition as taught in the module Cognitive Systems, is expected.





Annotation

The course is partially given in German and English.

T**7.51 Course: Deep Learning for Computer Vision II: Advanced Topics [T-INFO-111494]****Responsible:** Prof. Dr.-Ing. Rainer Stiefelhagen**Organisation:** KIT Department of Informatics**Part of:** [M-INFO-105755 - Deep Learning for Computer Vision II: Advanced Topics](#)

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

Events					
WT 22/23	2400258	Deep Learning for Computer Vision II: Advanced Topics	2 SWS	Lecture / 	Stiefelhagen, Roitberg, Sarfraz



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





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7.52 Course: Design of Electrical Machines [T-ETIT-100785]

Responsible: Prof. Dr. Martin Doppelbauer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100515 - Design of Electrical Machines](#)

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

Events					
WT 22/23	2306324	Design of Electrical Machines	2 SWS	Lecture / 	Doppelbauer
WT 22/23	2306325	Tutorial for 2306324 Design of Electrical Machines	1 SWS	Practice / 	Doppelbauer

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

Prerequisites

none

Recommendation





Modul: Elektrische Maschinen und Stromrichter

T**7.53 Course: Design Principles for Interactive Real-Time Systems [T-INFO-101290]**

Responsible: Prof. Dr.-Ing. Jürgen Beyerer
Organisation: KIT Department of Informatics
Part of: [M-INFO-100753 - Design Principles for Interactive Real-Time Systems](#)

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


Events					
ST 2023	24648	Design Principles for Interactive Real-Time Systems	2 SWS	Lecture / 	Peinsipp-Byma, Sauer





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

T

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

Responsible: Dipl.-Ing. Markus Liedel**Organisation:** KIT Department of Mechanical Engineering**Part of:** M-MACH-102712 - Design with Plastics**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each summer term**Version**
1**Events**

ST 2023	2174571	Design with Plastics	2 SWS	Block / 	Liedel
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Competence Certificate**

Oral exam, about 20 minutes

Prerequisites

none

Recommendation



Poly I





T

7.55 Course: Digital Beam-Forming for Imaging Radar [T-ETIT-110940]

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-105415 - Digital Beam-Forming for Imaging Radar](#)

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

Events					
WT 22/23	2308450	Digital Beam-Forming for Imaging Radar	2 SWS	Lecture / 	Younis
WT 22/23	2308451	Tutorial for 2308450 Digital Beam-Forming for Imaging Radar	1 SWS	Practice / 	Younis

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

Competence Certificate

Written Exam approx. 120 Min.

Prerequisites

The basic principles will be repeated in the lecture. The following lectures are helpful for a comprehensive understanding: Radar System Engineering (engl.), Antennen und Mehrantennensysteme, Spaceborne Radar Remote Sensing (engl.), Modern Radio System Engineering (engl.)

Recommendation

Basics of signal processing and radar techniques are useful.

T

7.56 Course: Digital Circuit Design [T-ETIT-100974]

Responsible: Prof. Dr. Ivan Peric
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100473 - Digital Circuit Design](#)



Type
Oral examination





Credits
4

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events					
ST 2023	2312683	Digital Circuit Design	2 SWS	Lecture / 	Peric
ST 2023	2312685	Übungen zu 2312683 Design digitaler Schaltkreise	1 SWS	Practice / 	Peric


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





T

7.57 Course: Digital Hardware Design Laboratory [T-ETIT-104571]

Responsible: Prof. Dr.-Ing. Jürgen Becker**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-102266 - Digital Hardware Design Laboratory](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each summer term	1

Events					
ST 2023	2311645	Digital Hardware Design Laboratory	4 SWS	Practical course / 	Becker

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

Control of success is carried out in an oral examination as well as during the laboratory exercises in form of laboratory reports and/or oral interrogations.

Prerequisites

none

Modeled Conditions

The following conditions have to be fulfilled:

1. The module [M-ETIT-102264 - Digital Hardware Design Laboratory](#) must not have been started.

Recommendation

Previous knowledge in design and design automation for electronic systems (e.g. from the lectures SAE, No. 23606, HSO, No. 23619 or HMS, No. 23608) is recommended.


Annotation





The module ETIT-102264 („Praktikum Entwurf digitaler Systeme“) must not have been started or completed.

T

7.58 Course: Digital Hardware Design Laboratory [T-ETIT-104570]**Responsible:** Prof. Dr.-Ing. Jürgen Becker**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-102264 - Digital Hardware Design Laboratory](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each summer term	1

Events					
ST 2023	2311637	Laboratory in Design Automation	4 SWS	Practical course / 	Becker

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

none

Modeled Conditions

The following conditions have to be fulfilled:

1. The module [M-ETIT-102266 - Digital Hardware Design Laboratory](#) must not have been started.



7.59 Course: Digital Twin Engineering [T-ETIT-112224]

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-106040 - Digital Twin Engineering](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each winter term	1

Events					
WT 22/23	2301486	Digital Twin Engineering	2 SWS	Lecture /	Barth

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

Competence Certificate

The examination takes place in form of other types of examination. It consists of a model library developed in the course of a semester-long project in the modeling language Modelica and a presentation of the library lasting 25 minutes. The quality of the model library is evaluated within the framework of the criteria: documentation, formal correctness, functionality, usability, HMI and modeling level of detail. The presentation is evaluated as an additional aspects. The overall impression is evaluated.


The assessment of the developed model library and the presentation of the library will be included in the module grade. More details will be given at the beginning of the course.





Prerequisites

none

T**7.60 Course: Digitalization of Products, Services & Production [T-MACH-108491]****Responsible:** Dr.-Ing. Bernd Pätzold**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105476 - Digitalization of Products, Services & Production](#)

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

Events					
WT 22/23	2122310	Digitalization of Products, Services & Production	2 SWS	Seminar / 	Pätzold

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

Assessment of another type. Two presentations in team work and two written compositions. Grading: each composition 1/6 and each presentation 2/3.

Prerequisites



none





T

7.61 Course: Distributed Discrete Event Systems [T-ETIT-100960]

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100361 - Distributed Discrete Event Systems](#)

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

Events					
ST 2023	2302106	Verteilte ereignisdiskrete Systeme	2 SWS	Lecture / 	Heizmann
ST 2023	2302108	Übungen zu 2302106 Verteilte ereignisdiskrete Systeme	1 SWS	Practice / 	N.N.

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

Prerequisites

none

T



7.62 Course: Drive Train of Mobile Machines [T-MACH-105307]





Responsible: Prof. Dr.-Ing. Marcus Geimer
Marco Wydra

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-105800 - Drive Train of Mobile Machines](#)

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

Events					
WT 22/23	2113077	Drive Train of Mobile Machines	2 SWS	Lecture / 	Geimer
WT 22/23	2113078	Übung zu 'Antriebsstrang mobiler Arbeitsmaschinen'	1 SWS	Practice / 	Geimer, Herr

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 every 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.

T



7.63 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-105612 - Dynamics of Electro-Mechanical Systems](#)

Type	Credits	Grading scale	Expansion	Version
Written examination	5	Grade to a third	1 terms	2

Events					
ST 2023	2162210	Dynamics of electro-mechanical systems	2 SWS	Lecture / 	Fidlin
ST 2023	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

T

7.64 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-102700 - Dynamics of the Automotive Drive Train](#)**Type**
Oral examination**Credits**
5**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1

Events					
WT 22/23	2163111	Dynamics of the Automotive Drive Train	2 SWS	Lecture / 	Fidlin
WT 22/23	2163112	Übungen zu Dynamik des Kfz-Antriebsstrangs	2 SWS	Practice	Fidlin, Gießler

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

Oral examination, 30 min.

Prerequisites

none

Recommendation

Powertrain Systems Technology A: Automotive SystemsMachine DynamicsVibration Theory

T**7.65 Course: Educational Development for Student Teachers - Basic Level [T-ETIT-100797]****Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)

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

Competence Certificate

Success monitoring consists of participation in attendance modules (attendance requirement of 80%) and submission of a written reflection portfolio.

Attendance is required both to perform the work as a team on-site and to provide practical techniques and skills that cannot be learned in pure self-study.

Prerequisites

Part-time work as a tutor at KIT during program participation.

T**7.66 Course: Elective Module - Subject, Body, Individual: the Other Side of
Sustainability - Self Assignment BeNe [T-ZAK-112349]****Organisation:****Part of:** [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

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

Competence Certificate

Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

Prerequisites

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation

The content of the Basics Module is helpful.

T**7.67 Course: Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe [T-ZAK-112348]****Organisation:****Part of:** [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

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

Competence Certificate

Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

Prerequisites

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation

The content of the Basics Module is helpful.

T

7.68 Course: Elective Module - Sustainability in Culture, Economy and Society - Self Assignment BeNe [T-ZAK-112350]

Organisation:

Part of: [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

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

Competence Certificate

Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

Prerequisites

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation

The content of the Basics Module is helpful.

T

7.69 Course: Elective Module - Sustainable Cities and Neighbourhoods - Self Assignment BeNe [T-ZAK-112347]

Organisation: University

Part of: [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

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

Competence Certificate

Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

Prerequisites

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation



The content of the Basics Module is helpful.





T

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

Responsible: Prof. Dr. Sebastian Kempf
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-102734 - Materials](#)

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

Events					
WT 22/23	2312700	Electrical Engineering Components	3 SWS	Lecture / 	Kempf
WT 22/23	2312701	Tutorial for 2312700 Electrical Engineering Components	1 SWS	Practice / 	Wünsch

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

Competence Certificate

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

Prerequisites

none

T

7.71 Course: Elements and Systems of Technical Logistics [T-MACH-102159]

Responsible: Georg Fischer
Dr.-Ing. Martin Mittwollen

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-102688 - Elements of Technical Logistics](#)
[M-MACH-105015 - Elements of Technical Logistics incl. Project](#)

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

Competence Certificate

The assessment consists of an oral exam (20min) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites

none

Recommendation

Knowledge out of "Basics of Technical Logistics I" (T-MACH-109919) preconditioned.

T**7.72 Course: Elements and Systems of Technical Logistics - Project [T-MACH-108946]**

Responsible: Georg Fischer
Dr.-Ing. Martin Mittwollen

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-105015 - Elements of Technical Logistics incl. Project](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each winter term	1

Competence Certificate

Presentation of performed project and defense (30min) according to §4 (2), No. 3 of the examination regulation

Prerequisites

T-MACH-102159 (Elements and Systems of Technical Logistics) must have been started

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-102159 - Elements and Systems of Technical Logistics](#) must have been started.

Recommendation

Knowledge out of "Basics of Technical Logistics I" (T-MACH-109919) preconditioned.

T

7.73 Course: Energy Informatics 1 [T-INFO-103582]

Responsible: Prof. Dr. Veit Hagenmeyer
Organisation: KIT Department of Informatics
Part of: [M-INFO-101885 - Energy Informatics 1](#)

Type
Oral examination

Credits
5

Grading scale
Grade to a third

Recurrence
Each winter term

Version
2

Events					
WT 22/23	2400058	Energy Informatics 1	4 SWS	Lecture / Practice (Hagenmeyer, Süß, An

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-INFO-110356 - Energy Informatics 1 - Preliminary Work](#) must have been passed.

T**7.74 Course: Energy Informatics 1 - Preliminary Work [T-INFO-110356]**

Responsible: Prof. Dr. Veit Hagenmeyer
Organisation: KIT Department of Informatics
Part of: [M-INFO-101885 - Energy Informatics 1](#)

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

T

7.75 Course: Energy Informatics 2 [T-INFO-106059]

Responsible: Prof. Dr. Veit Hagenmeyer
Organisation: KIT Department of Informatics
Part of: [M-INFO-103044 - Energy Informatics 2](#)

Type
Oral examination

Credits
5

Grading scale
Grade to a third

Recurrence
Each summer term

Version
2

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-INFO-103582 - Energy Informatics 1](#) must have been passed.
2. The course [T-INFO-110356 - Energy Informatics 1 - Preliminary Work](#) must have been passed.

T

7.76 Course: Energy Systems Analysis [T-WIWI-102830]




Responsible: Dr. Armin Ardone
Prof. Dr. Wolf Fichtner

Organisation: KIT Department of Economics and Management

Part of: [M-WIWI-100499 - Energy Systems Analysis](#)

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

Events					
WT 22/23	2581002	Energy Systems Analysis	2 SWS	Lecture / 	Fichtner, Ardone, Dengiz, Yilmaz

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

Competence Certificate

The assessment consists of a written exam (60 minutes) (following §4(2) of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date. Depending on the respective pandemic situation, the exam may be offered as an open book exam (alternative exam assessment, following §4(2), 3 of the examination regulation).

Prerequisites

None

Recommendation

None



Annotation





Since 2011 the lecture is offered in winter term. Exams can still be taken in summer term.

T

7.77 Course: Engineering Mechanics IV [T-MACH-105274]**Responsible:** Prof. Dr.-Ing. Wolfgang Seemann**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-103205 - Engineering Mechanics](#)

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

Events					
ST 2023	2162231	Engineering Mechanics IV	2 SWS	Lecture / 	Fidlin
ST 2023	2162232	Engineering Mechanics IV (Tutorial)	2 SWS	Practice / 	Fidlin, Kaupp, Luo

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

Written examination

Prerequisites

Application and exam is allowed only in one lecture of this modul (M-MACH-103205 - Technische Mechanik). "T-MACH-105209 - Einführung in die Mehrkörperdynamik", "T-MACH-105274 - Technische Mechanik IV" or "T-MACH-100297 - Mathematische Methoden der Festigkeitslehre".

T


7.78 Course: Engineer's Field of Work [T-MACH-105721]





Responsible: Prof. Dr. Martin Doppelbauer
Prof. Dr.-Ing. Marcus Geimer

Organisation: KIT Department of Mechanical Engineering

Part of: [M-ETIT-103248 - Key Competences](#)
[M-MACH-102755 - Engineer's Field of Work](#)

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

Events					
ST 2023	2114917	Engineer's Field of Work	2 SWS	Lecture / 	Doppelbauer, Geimer

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

Competence Certificate

written test

Duration: 60 minutes

result: passed / not passed

No tools or reference materials may be used during the exam.

Prerequisites



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T

7.79 Course: Entrepreneurship [T-WIWI-102864]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: [M-ETIT-105073 - Student Innovation Lab](#)

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

Events					
WT 22/23	2545001	Entrepreneurship	2 SWS	Lecture / 	Terzidis
ST 2023	2545001	Entrepreneurship	2 SWS	Lecture / 	Terzidis, Dang

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

Competence Certificate

The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

Students are offered the opportunity to earn a grade bonus through separate assignments. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by a maximum of one grade level (0.3 or 0.4). The exact criteria for awarding a bonus will be announced at the beginning of the lecture.

Prerequisites

None

Recommendation



None




T

7.80 Course: Ethics of Technology - ARs ReflecTlonis [T-ETIT-111923]

Responsible: Dr. phil. Michael Kühler**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)


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





Events					
WT 22/23	9003013	ARS REFLECTIONIS. Thinking and Acting Responsibly in Engineering, Science, and Innovation		Block / 	Kühler, Does
ST 2023	9003013	ARS REFLECTIONIS. Thinking and Acting Responsibly in Engineering, Science, and Innovation		Block / 	Kühler, Does

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

none

T**7.81 Course: Fabrication Processes in Microsystem Technology [T-MACH-102166]****Responsible:** Dr. Klaus Bade**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105478 - Fabrication Processes in Microsystem Technology](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each term**Version**
1

Events					
WT 22/23	2143882	Fabrication Processes in Microsystem Technology	2 SWS	Lecture / 	Bade

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

Oral examination, 20 minutes

Prerequisites

none

T

7.82 Course: Field Propagation and Coherence [T-ETIT-100976]

Responsible: Prof. Dr. Wolfgang Freude
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100566 - Field Propagation and Coherence](#)



Type
Oral examination





Credits
4

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events					
WT 22/23	2309466	Field Propagation and Coherence	2 SWS	Lecture / 	Freude, Maier, Reichenbacher
WT 22/23	2309467	Tutorial for 2309466 Field Propagation and Coherence	1 SWS	Practice / 	Freude, N.N.

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



Prerequisites





none

T

7.83 Course: Fundamentals in the Development of Commercial Vehicles [T-MACH-111389]**Responsible:** Christof Weber**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105824 - Fundamentals in the Development of Commercial Vehicles](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	see Annotations	2 terms	2

Events					
WT 22/23	2113812	Fundamentals in the Development of Commercial Vehicles I	1 SWS	Lecture / 	Weber
ST 2023	2114844	Fundamentals in the Development of Commercial Vehicles II	1 SWS	Lecture / 	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

T

7.84 Course: Fundamentals of Automobile Development I [T-MACH-105162]**Responsible:** Prof.Dipl.-Ing. Rolf Frech**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105289 - Principles of Whole Vehicle Engineering I](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	2	Grade to a third	Each winter term	1

Events					
WT 22/23	2113810	Fundamentals of Automobile Development I	1 SWS	Lecture / 	Frech
WT 22/23	2113851	Principles of Whole Vehicle Engineering I	1 SWS	Lecture / 	Frech

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

Written examination

Duration: 90 minutes

Auxiliary means: none



Prerequisites




none

T

7.85 Course: Fundamentals of Automobile Development II [T-MACH-105163]**Responsible:** Prof.Dipl.-Ing. Rolf Frech**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105290 - Principles of Whole Vehicle Engineering II](#)

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

Events					
ST 2023	2114842	Principles of Whole Vehicle Engineering II	1 SWS	Block / 	Frech
ST 2023	2114860	Principles of Whole Vehicle Engineering II	1 SWS	/ 	Frech

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Competence Certificate**

Written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites





none





T

7.86 Course: Fundamentals of Combustion I [T-MACH-105213]

Responsible: Prof. Dr. Ulrich Maas**Organisation:** KIT Department of Mechanical Engineering**Part of:** M-MACH-102707 - Fundamentals of Combustion I

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

Events					
WT 22/23	2165515	Fundamentals of Combustion I	2 SWS	Lecture / 	Maas
WT 22/23	2165517	Fundamentals of Combustion I (Tutorial)	1 SWS	Practice / 	Bykov
WT 22/23	3165016	Fundamentals of Combustion I	2 SWS	Lecture / 	Maas
WT 22/23	3165017	Fundamentals of Combustion I (Tutorial)	1 SWS	Practice / 	Bykov

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

Written exam, approx. 3 hours

Prerequisites

none

T



7.87 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-102690 - Fundamentals of Energy Technology](#)

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

Events					
ST 2023	2130927	Fundamentals of Energy Technology	3 SWS	Lecture / 	Cheng, Badea
ST 2023	3190923	Fundamentals of Energy Technology	3 SWS	Lecture / 	Badea

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

Competence Certificate

Written examination, 90 min

Prerequisites

none



7.88 Course: Fuzzy Sets [T-INFO-101376]

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: [M-INFO-100839 - Fuzzy Sets](#)

Type
Oral examination

Credits
6

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events					
ST 2023	24611	Fuzzy Sets	3 SWS	Lecture /	Pfaff

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


T




7.89 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-105288 - Handling Characteristics of Motor Vehicles I](#)

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

Events					
WT 22/23	2113807	Handling Characteristics of Motor Vehicles I	2 SWS	Lecture / 	Unrau

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

Competence Certificate

Verbally

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites

none

T



7.90 Course: Hardware Modeling and Simulation [T-ETIT-100672]





Responsible: Dr.-Ing. Jens Becker
Prof. Dr.-Ing. Jürgen Becker

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-100449 - Hardware Modeling and Simulation](#)

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

Events					
WT 22/23	2311608	Hardware Modeling and Simulation	2 SWS	Lecture / 	Becker, Becker
WT 22/23	2311610	Tutorial for 2311608 Hardware Modeling and Simulation	1 SWS	Practice / 	Unger

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

Competence Certificate

Achievement is examined in the form of a written examination lasting 120 minutes.

Prerequisites

none

Recommendation

Lecture „Systems and Software Engineering“ (23605)

Annotation

During semester written, otherwise oral examination.

From WS 19/20 the module will be managed by Prof. Jürgen Becker and Dr. Jens Becker.

From WS 19/20 the module is offered in WS.

T

7.91 Course: Hardware Synthesis and Optimisation [T-ETIT-100673]

Responsible: Prof. Dr.-Ing. Jürgen Becker
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100452 - Hardware Synthesis and Optimisation](#)



Type
Oral examination





Credits
6

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events					
ST 2023	2311619	Hardware Synthesis and Optimisation	3 SWS	Lecture / 	Becker
ST 2023	2311621	Tutorial for 2311619 Hardware Synthesis and Optimisation	1 SWS	Practice / 	Schmidt

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

Competence Certificate

Achievement will be examined in an oral examination (approx. 20 minutes).



Prerequisites





none

T

7.92 Course: Hardware/Software Co-Design [T-ETIT-100671]

Responsible: Dr.-Ing. Oliver Sander**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100453 - Hardware/Software Co-Design](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1

Events					
WT 22/23	2311620	Hardware/Software Co-Design	2 SWS	Lecture / 	Sander, Becker
WT 22/23	2311623	Tutorial for 2311620 Hardware/Software Co-Design	1 SWS	Practice / 	Harbaum

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

Achievement will be examined in an oral examination (approx. 20 minutes).

Prerequisites

none

T



7.93 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-102717 - Heat and Mass Transfer](#)

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

Events					
WT 22/23	2165512	Heat and mass transfer	2 SWS	Lecture / 	Maas
ST 2023	3122512	Heat and Mass Transfer	2 SWS	Lecture / 	Maas

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

Competence Certificate

Written exam, approx. 3 h

Prerequisites



none





T

7.94 Course: High-Voltage Technology [T-ETIT-110266]

Responsible: Dr.-Ing. Rainer Badent**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-105060 - High-Voltage Technology](#)

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



Events					
WT 22/23	2307360	High-Voltage Technology	2 SWS	Lecture / 	Badent
WT 22/23	2307362	Tutorial for 2307362High-Voltage Technology	1 SWS	Practice / 	Badent, Zajadatz





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

T

7.95 Course: High-Voltage Test Technique [T-ETIT-101915]



Responsible: Dr.-Ing. Rainer Badent**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100417 - High-Voltage Test Technique](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1





Events					
WT 22/23	2307392	High-Voltage Test Technique	2 SWS	Lecture / 	Badent
WT 22/23	2307394	Tutorial for 2307392 High-Voltage Test Technique	2 SWS	Practice / 	Gielnik

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

none

T**7.96 Course: Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy [T-INFO-101262]****Responsible:** Prof. Dr.-Ing. Tamim Asfour
Hon.-Prof. Dr. Uwe Spetzger**Organisation:** KIT Department of Informatics**Part of:** [M-INFO-100725 - Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy](#)**Type**
Written examination**Credits**
3**Grading scale**
Grade to a third**Recurrence**
Each term**Version**
2

Events					
WT 22/23	24139	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	2 SWS	Lecture / 	Spetzger
ST 2023	24678	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	2 SWS	Lecture / 	Spetzger





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

T**7.97 Course: Human-Machine-Interaction [T-INFO-101266]**

Responsible: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: [M-INFO-100729 - Human Computer Interaction](#)

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

Events					
ST 2023	24659	Human-Computer-Interaction	2 SWS	Lecture / 	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**7.98 Course: Human-Machine-Interaction in Anthropomatics: Basics [T-INFO-101361]**





Responsible: Prof. Dr.-Ing. Jürgen Beyerer
Dr. Jürgen Geisler

Organisation: KIT Department of Informatics

Part of: [M-INFO-100824 - Human-Machine-Interaction in Anthropomatics: Basics](#)

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

Events					
WT 22/23	24100	Human-Machine-Interaction in Anthropomatics: Basics	2 SWS	Lecture / 	van de Camp



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





T

7.99 Course: Human-Machine-Interaction Pass [T-INFO-106257]

Responsible: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: [M-INFO-100729 - Human Computer Interaction](#)

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

Events					
ST 2023	2400095	Human-Computer-Interaction	1 SWS	Practice / 	Beigl
ST 2023	24659	Human-Computer-Interaction	2 SWS	Lecture / 	Beigl

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

T

7.100 Course: Humanoid Robotics Laboratory [T-INFO-111590]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [M-INFO-105792 - Humanoid Robotics Laboratory](#)


Type
Oral examination





Credits
6

Grading scale
Grade to a third

Recurrence
Each winter term

Version
2

Events					
WT 22/23	24890	Humanoid Robotics Laboratory	4 SWS	Practical course / 	Asfour

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

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-INFO-105142 - Humanoid Robots - Practical Course](#) must not have been started.

Recommendation

- Very good programming skills in at least one high-level programming language are strongly recommended.
- Attendance of the lectures Robotics 1, Robotics 2, Robotics 3, as well as the robotics practical course are recommended.
- Project-specific recommendations (knowledge of C++, Python, ...) will be announced in the individual project descriptions

Annotation

- Internship dates are always by arrangement with the supervising staff member.
- An extension work of the topic as a master thesis is possible in principle.
- The number of participants in this practical course is generally **limited** and varies with the number of available research projects at the institute.







7.101 Course: Humanoid Robots - Seminar [T-INFO-105144]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [M-INFO-102561 - Humanoid Robots - Seminar](#)

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

Events					
WT 22/23	2400048	Seminar Humanoid Robots	2 SWS	Seminar / 	Asfour

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

Competence Certificate

The assessment is carried out as an examination of another type (§ 4 Abs. 2 No. 3 SPO). It includes a presentation at the end of the term and a term paper.

Prerequisites

none.

Recommendation

Attending the lectures Robotics I – Introduction to Robotics, Robotics II: Humanoid Robotics, Robotics III – Sensors and Perception in Robotics, Mechano-Informatics and Robotics and Wearable Robotic Technologies is recommended.

T**7.102 Course: In-depth Module - Doing Culture - Self Assignment BAK [T-ZAK-112655]**

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: [M-ZAK-106235 - Supplementary Studies on Culture and Society](#)

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

Competence Certificate

At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).

In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.

The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization. In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

Prerequisites

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Annotation

The content of the Basic Modul is helpful.

T**7.103 Course: In-depth Module - Global Cultures - Self Assignment BAK [T-ZAK-112658]**

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: [M-ZAK-106235 - Supplementary Studies on Culture and Society](#)

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

Competence Certificate

At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).

In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.

The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization. In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

Prerequisites

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Annotation

The content of the Basic Modul is helpful.

T**7.104 Course: In-depth Module - Media & Aesthetics - Self Assignment BAK [T-ZAK-112656]**

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: [M-ZAK-106235 - Supplementary Studies on Culture and Society](#)

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

Competence Certificate

At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).

In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.

The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization. In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

Prerequisites

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Annotation

The content of the Basic Modul is helpful.

T**7.105 Course: In-depth Module - Spheres of Life - Self Assignment BAK [T-ZAK-112657]**

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: [M-ZAK-106235 - Supplementary Studies on Culture and Society](#)

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

Competence Certificate

At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).

In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.

The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization. In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

Prerequisites

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Annotation

The content of the Basic Modul is helpful.

T**7.106 Course: In-depth Module - Technology & Responsibility - Self Assignment BAK [T-ZAK-112654]**

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: [M-ZAK-106235 - Supplementary Studies on Culture and Society](#)

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

Competence Certificate

At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).

In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.

The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization. In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

Prerequisites

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Annotation

The content of the Basic Modul is helpful.





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7.107 Course: Industrial Business Administration [T-WIWI-100796]

Responsible: Prof. Dr. Wolf Fichtner
Organisation: KIT Department of Economics and Management
Part of: [M-ETIT-103248 - Key Competences](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (written)	3	pass/fail	Each winter term	1

Events					
WT 22/23	2581040	Industrial Business Administration	2 SWS	Lecture / 	Fichtner

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


Competence Certificate





The assessment of this course is a ungraded written examination (60 min).

Prerequisites

None

T**7.108 Course: Industrial Circuitry [T-ETIT-100716]****Responsible:** Dr.-Ing. Andreas Liske**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100399 - Industrial Circuitry](#)**Type**
Oral examination**Credits**
3**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1**Events**

WT 22/23	2306327	Industrial Circuitry	2 SWS	Lecture / 	Liske
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**




none

T

7.109 Course: Information Engineering [T-MACH-102209]**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-101283 - Virtual Engineering A](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	2

Events					
ST 2023	2122014	Information Engineering	2 SWS	Seminar / 	Ovtcharova, Mitarbeiter

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Competence Certificate**

Alternative exam assessment (written composition and speech)

Prerequisites



None





T

7.110 Course: Information Fusion [T-ETIT-106499]

Responsible: Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-103264 - Information Fusion](#)

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

Events					
WT 22/23	2302139	Information Fusion	2 SWS	Lecture / 	Heizmann
WT 22/23	2302141	Exercise for 2302139 Information Fusion	1 SWS	Practice / 	Heizmann, Bihler

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

Prerequisites

none

T**7.111 Course: Information Processing in Sensor Networks [T-INFO-101466]**





Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: [M-INFO-100895 - Information Processing in Sensor Networks](#)

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

T**7.112 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-105281 - Information Systems and Supply Chain Management](#)

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

Events					
ST 2023	2118094	Information Systems in Logistics and Supply Chain Management	2 SWS	Lecture / 	Kilger

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

T**7.113 Course: Information Technology in Industrial Automation Systems [T-ETIT-100698]****Responsible:** Dr.-Ing. Peter-Axel Bort**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100367 - Information Technology in Industrial Automation Systems](#)**Type**
Oral examination**Credits**
3**Grading scale**
Grade to a third**Recurrence**
Each summer term**Version**
1

Events					
ST 2023	2302144	Informationstechnik in der industriellen Automation	2 SWS	Lecture / 	Bort

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

none

T


7.114 Course: Innovation Lab [T-ETIT-110291]



Responsible: Prof. Dr.-Ing. Sören Hohmann
 Prof. Dr. Werner Nahm
 Prof. Dr.-Ing. Eric Sax
 Prof. Dr. Wilhelm Stork
 Prof. Dr.-Ing. Thomas Zwick

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-105073 - Student Innovation Lab](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	9	Grade to a third	Each winter term	2 terms	1


Events					
WT 22/23	2303192	Innovation Lab	2 SWS	Project (P / )	Hohmann, Zwick, Sax, Stork, Nahm





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

Competence Certificate

see module description

T**7.115 Course: Innovative Concepts for Programming Industrial Robots [T-INFO-101328]****Responsible:** Prof. Dr.-Ing. Björn Hein**Organisation:** KIT Department of Informatics**Part of:** [M-INFO-100791 - Innovative Concepts for Programming Industrial Robots](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1

Events					
ST 2023	24179	Innovative Konzepte zur Programmierung von Industrierobotern	2 SWS	Lecture / 	Hein

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



7.116 Course: Integrated Intelligent Sensors [T-ETIT-100961]

Responsible: Prof. Dr. Wilhelm Stork
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100457 - Integrated Intelligent Sensors](#)

Type
Oral examination

Credits
3

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events

ST 2023	2311630	Integrated Intelligent Sensors	2 SWS	Lecture /	Stork
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate

Achievement will be examined in an oral examination (approx. 20 minutes).

Prerequisites

none

T




7.117 Course: Integrated Product Development [T-MACH-105401]





Responsible: Prof. Dr.-Ing. Albert Albers
Albers Assistenten

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-102626 - Major Field: Integrated Product Development](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	18	Grade to a third	Each winter term	2

Events					
WT 22/23	2145156	Lecture: IP - Integrated Product Development	4 SWS	Lecture / 	Albers
WT 22/23	2145157	Workshop: IP - Integrated Product Development	4 SWS	Practice / 	Albers, Mitarbeiter, Thümmel, Tröster
WT 22/23	2145300	Project Work: IP - Integrated Product Development	2 SWS	Others (sons / 	Albers, Thümmel, Tröster

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

Competence Certificate

oral examination (60 minutes)

Prerequisites

none

Annotation



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





T

7.118 Course: Integrated Systems and Circuits [T-ETIT-100972]

Responsible: Prof. Dr. Sebastian Kempf
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100474 - Integrated Systems and Circuits](#)

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

Events					
ST 2023	2312688	Integrated Systems and Circuits	2 SWS	Lecture / 	Ilin
ST 2023	2312690	Tutorial for 2312688 Integrated Systems and Circuits	1 SWS	Practice / 	Wünsch

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

Prerequisites

none

T

7.119 Course: Intellectual Property Rights and Strategies in Industrial Companies [T-MACH-105442]





Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dipl.-Ing. Frank Zacharias

Organisation: KIT Department of Mechanical Engineering

Part of: [M-ETIT-103248 - Key Competences](#)

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

Events					
WT 22/23	2147161	Intellectual Property Rights and Strategies in Industrial Companies	2 SWS	Block / 	Zacharias
ST 2023	2147160	Patents and Patentstrategies in innovative companies	2 SWS	/ 	Zacharias

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

Competence Certificate

oral exam (ca. 20 min)

Prerequisites

none


Recommendation




None

T

7.120 Course: International Production Engineering A [T-MACH-110334]**Responsible:** Prof. Dr.-Ing. Jürgen Fleischer**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105109 - International Production Engineering](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	3

Events					
ST 2023	2150600	International Production Engineering A	2 SWS	Lecture / 	Fleischer

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Competence Certificate**

Alternative test achievement (graded):

- Result of the project work and final presentation with weighting 65%
- Oral exam (ca. 15 min) with weighting 35%

Prerequisites

One of the following courses must be started:

- T-MACH-108844 - Automated Manufacturing Systems
- T-MACH-109055 - Machine Tools and Industrial Handling
- T-MACH-110962 - Machine Tools and High-Precision Manufacturing Systems

Modeled Conditions

You have to fulfill one of 3 conditions:

1. The course [T-MACH-108844 - Automated Manufacturing Systems](#) must have been started.
2. The course T-MACH-109055 - Machine Tools and Industrial Handling must have been started.
3. The course [T-MACH-110962 - Machine Tools and High-Precision Manufacturing Systems](#) must have been started.

Recommendation

This course should be attended in combination with International Production Engineering B in the next winter semester.



7.121 Course: International Production Engineering B [T-MACH-110335]

Responsible: Prof. Dr.-Ing. Jürgen Fleischer

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-105109 - International Production Engineering](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each winter term	3

Events					
WT 22/23	2149620	International Production Engineering B	2 SWS	Lecture /	Fleischer

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

Competence Certificate

Alternative test achievement (graded):

- Result of the project work and final presentation with weighting 65%
- Oral exam (ca. 15 min) with weighting 35%

Prerequisites

The following course must be started:

- T-MACH-110334 - International Production Engineering A

Furthermore successful completion of one of the following courses:

- T-MACH-108844 - Automated Manufacturing Systems
- T-MACH-109055 - Machine Tools and Industrial Handling
- T-MACH-110962 - Machine Tools and High-Precision Manufacturing Systems

Modeled Conditions

The following conditions have to be fulfilled:

- You have to fulfill one of 3 conditions:
 - The course [T-MACH-108844 - Automated Manufacturing Systems](#) must have been passed.
 - The course T-MACH-109055 - Machine Tools and Industrial Handling must have been passed.
 - The course [T-MACH-110962 - Machine Tools and High-Precision Manufacturing Systems](#) must have been passed.
- The course [T-MACH-110334 - International Production Engineering A](#) must have been started.

T

7.122 Course: Introduction to Energy Economics [T-WIWI-102746]

Responsible: Prof. Dr. Wolf Fichtner
Organisation: KIT Department of Economics and Management
Part of: [M-WIWI-100498 - Introduction into Energy Economics](#)



Type
Written examination





Credits
5

Grading scale
Grade to a third

Recurrence
Each summer term

Version
4

Events					
ST 2023	2581010	Introduction to Energy Economics	2 SWS	Lecture / 	Fichtner
ST 2023	2581011	Übungen zu Einführung in die Energiewirtschaft	2 SWS	Practice / 	Lehmann, Sandmeier, Ardone, Fichtner

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

Competence Certificate

The assessment consists of a written exam (90 minutes) (following §4(2) of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date. Depending on the respective pandemic situation, the exam may be offered as an open book exam (alternative exam assessment, following §4(2), 3 of the examination regulation).

Prerequisites

None.

T


7.123 Course: Introduction to Microsystem Technology I [T-MACH-105182]





Responsible: Dr. Vlad Badilita
Dr. Mazin Jouda
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-102691 - Introduction to Microsystem Technology I](#)

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

Events					
WT 22/23	2141861	Introduction to Microsystem Technology I	2 SWS	Lecture / 	Korvink, Badilita

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

Competence Certificate

written examination (60 min)

Prerequisites

none

T

7.124 Course: Introduction to Microsystem Technology II [T-MACH-105183]

Responsible: Dr. Mazin Jouda
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-102706 - Introduction to Microsystem Technology II](#)


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




Competence Certificate
written examination (60 min)

Prerequisites
none

T

7.125 Course: Introduction to Multi-Body Dynamics [T-MACH-105209]**Responsible:** Prof. Dr.-Ing. Wolfgang Seemann**Organisation:** KIT Department of Mechanical Engineering**Part of:** **M-MACH-103205 - Engineering Mechanics****Type**
Written examination**Credits**
5**Grading scale**
Grade to a third**Recurrence**
Each summer term**Version**
2

Events					
ST 2023	2162235	Introduction to Multibody Dynamics	3 SWS	Lecture / 	Römer

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Competence Certificate**

Written examination, 180 min.

Prerequisites



Application and exam is allowed only in one lecture of this modul (M-MACH-103205 - Technische Mechanik). "T-MACH-105209 - Einführung in die Mehrkörperdynamik", "T-MACH-105274 - Technische Mechanik IV" or "T-MACH-100297 - Mathematische Methoden der Festigkeitslehre".





Recommendation

Engineering Mechanics III/IV

T**7.126 Course: Introduction to the Scientific Method (Seminar, German) [T-ETIT-111316]****Responsible:** Prof. Dr. Werner Nahm**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)

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

Events					
WT 22/23	2305504	Einführung in die wissenschaftliche Methode	1 SWS	Seminar / 	Nahm
ST 2023	2305744	Einführung in die wissenschaftliche Methode	1 SWS	Seminar / 	Nahm

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

none





T

7.127 Course: IoT Platform for Engineering [T-MACH-106743]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova**Organisation:** KIT Department of Mechanical Engineering**Part of:** M-MACH-101283 - Virtual Engineering A

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

Events					
WT 22/23	2123352	IoT platform for engineering	3 SWS	Project (P / )	Ovtcharova, Maier
ST 2023	2123352	IoT platform for engineering	3 SWS	Project (P / )	Ovtcharova, Maier

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

Competence Certificate

Assessment of another type (graded), Group teaching project on Industry 4.0 consisting of: Conception, implementation, accompanying documentation and final presentation.



7.128 Course: IT-Fundamentals of Logistics [T-MACH-105187]

Responsible: Prof. Dr.-Ing. Frank Thomas

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-105282 - IT-Fundamentals of Logistics: Opportunities for Digital Transformation](#)

Type
Oral examination

Credits
4

Grading scale
Grade to a third

Recurrence
Each summer term

Version
4

Events					
ST 2023	2118184	Future-oriented IT integration in logistics	2 SWS	Lecture /	Thomas

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

T**7.129 Course: Lab Computer-Aided Methods for Measurement and Control [T-MACH-105341]****Responsible:** Prof. Dr.-Ing. Christoph Stiller**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105291 - Lab Computer-Aided Methods for Measurement and Control](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	1

Events					
WT 22/23	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

T**7.130 Course: Lab Course Electrical Drives and Power Electronics [T-ETIT-100718]**

Responsible: Prof. Dr. Martin Doppelbauer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100401 - Lab Course Electrical Drives and Power Electronics](#)


Type
Oral examination





Credits
6

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events					
ST 2023	2306331	Lab Course Electrical Drives and Power Electronics	4 SWS	Practical course / 	N.N., Becker

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

Prerequisites

none

T

7.131 Course: Lab Course Electrical Power Engineering [T-ETIT-100728]

Responsible: Dr.-Ing. Rainer Badent
Prof. Dr. Martin Doppelbauer
Prof. Dr.-Ing. Thomas Leibfried

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-100419 - Lab Course Electrical Power Engineering](#)


Type
Oral examination




Credits
6

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events					
WT 22/23	2307398	Lab Course Electrical Power Engineering	4 SWS	Practical course / 	Badent, N.N.

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

Competence Certificate

Success is checked in the form of an oral examination. The overall grade results from the 8 attempts.

Prerequisites



none





T

7.132 Course: Lab Course on Nanoelectronics [T-ETIT-100757]

Responsible: Prof. Dr. Sebastian Kempf
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100468 - Lab Course on Nanoelectronics](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	1

Events					
WT 22/23	2312669	Laboratory Nanoelectronics	4 SWS	Practical course / 	Kempf, weitere Mitarbeitende
ST 2023	2312669	Laboratory Nanoelectronic Technology	4 SWS	Practical course / 	Kempf

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


Prerequisites





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T

7.133 Course: Laboratory Biomedical Engineering [T-ETIT-101934]**Responsible:** Prof. Dr. Werner Nahm**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100389 - Laboratory Biomedical Engineering](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each summer term	3

Events					
ST 2023	2305276	Laboratory Biomedical Engineering	4 SWS	Practical course / 	Nahm

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

Passed exam of the module "Biomedizinische Messtechnik I".

Modeled Conditions

You have to fulfill one of 2 conditions:


1. The course [T-ETIT-106492 - Biomedical Measurement Techniques I](#) must have been passed.
2. The course T-ETIT-101928 - Biomedical Measurement Techniques I must have been passed.





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7.134 Course: Laboratory Digital Signal Processing [T-ETIT-101935]

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100364 - Laboratory Digital Signal Processing](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1

Events					
ST 2023	2302134	Praktikum Digitale Signalverarbeitung	4 SWS	Practical course / 	Tabuchi Barczak, Heizmann

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

Prerequisites



none





T

7.135 Course: Laboratory FPGA Based Circuit Design [T-ETIT-100759]

Responsible: Prof. Dr. Sebastian Kempf
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100470 - Laboratory FPGA Based Circuit Design](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	1

Events					
WT 22/23	2312674	Laboratory FPGA Based Circuit Design	4 SWS	Practical course / 	Kempf, Wunsch
ST 2023	2312674	Laboratory FPGA Based Circuit Design	4 SWS	Practical course / 	Kempf, Wunsch

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


Prerequisites





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T**7.136 Course: Laboratory Information Systems in Power Engineering [T-ETIT-100727]**

Responsible: Prof. Dr.-Ing. Thomas Leibfried
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100415 - Laboratory Information Systems in Power Engineering](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each summer term	1

Events					
ST 2023	2307388	Praktikum: Informationssysteme in der elektrischen Energietechnik	4 SWS	Practical course / 	Leibfried, und Mitarbeiter

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

Prerequisites


none





T

7.137 Course: Laboratory Mechatronic Measurement Systems [T-ETIT-106854]

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-103448 - Laboratory Mechatronic Measurement Systems](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 22/23	2302123	Laboratory Mechatronic Measurement Systems	4 SWS	Practical course / 	Heizmann, Steffens

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

Competence Certificate

The success control is carried out in the form of a written test of 120 minutes. If there are fewer than 20 candidates, an oral exam of around 20 minutes can alternatively take place. The module grade is the grade of the written or oral exam.

Prerequisites

none

Recommendation

Knowledge from the lectures "Metrology" or "Metrology in Mechatronics" and "Manufacturing Metrology" as well as basic knowledge of programming (e.g. in Matlab, C / C++) are helpful.

Annotation

Annotations

The submission of the protocols of all experiments is required for admission to the examination. The quality of the protocols is assessed; for the admission to the exam, the quality must be acceptable.

Attendance of all laboratory dates including the introductory event is required. Already in the event of a single unexcused absence, admission to the examination will not be granted.

T

7.138 Course: Laboratory Mechatronics [T-MACH-105370]

Responsible: Prof. Dr. Veit Hagenmeyer
 Prof. Dr.-Ing. Wolfgang Seemann
 Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: **M-MACH-102699 - Laboratory Mechatronics**

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

Events					
WT 22/23	2105014	Laboratory mechatronics	3 SWS	Practical course / ●	Fidlin, Hagenmeyer, Böhland, Stiller, Chen, Orth, Immel

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

T

7.139 Course: Laboratory Nanotechnology [T-ETIT-100765]**Responsible:** Prof. Dr. Ulrich Lemmer**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100478 - Laboratory Nanotechnology](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	1

Events					
WT 22/23	2313714	Laboratory Nanotechnology	4 SWS	Practical course / 	Lemmer, Trampert
ST 2023	2313714	Laboratory Nanotechnology	4 SWS	Practical course / 	Trampert, Lemmer



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





none

T

7.140 Course: Laboratory Optoelectronics [T-ETIT-100764]**Responsible:** Dr.-Ing. Klaus Trampert**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100477 - Laboratory Optoelectronics](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	1

Events					
WT 22/23	2313712	Laboratory Optoelectronics	4 SWS	Practical course / 	Kling, Trampert
ST 2023	2313712	Laboratory Optoelectronics	4 SWS	Practical course / 	Trampert, Kling

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

none



7.141 Course: Laboratory Solar Energy [T-ETIT-104686]

Responsible: Dr.-Ing. Klaus Trampert

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-102350 - Laboratory Solar Energy](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	1

Events					
WT 22/23	2313716	Laboratory Solar Energy	4 SWS	Practical course /	Richards, Trampert, Paetzold
ST 2023	2313708	Laboratory Solar Energy	4 SWS	Practical course /	Trampert, Paetzold, Richards

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

Prerequisites

none

T


7.142 Course: Leadership in Interdisciplinary Teams [T-MACH-106460]





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

Organisation: KIT Department of Mechanical Engineering

Part of: [M-ETIT-103248 - Key Competences](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	1

Events					
WT 22/23	2145189	Leadership in interdisciplinary teams	2 SWS	Others (sons / )	Matthiesen

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

Competence Certificate
oral colloquium, ungraded

Prerequisites
none

Annotation
NwT students attend only part of the lecture

T

7.143 Course: Lighting Engineering [T-ETIT-100772]

Responsible: Prof. Dr. Cornelius Neumann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100485 - Lighting Engineering](#)


Type
Oral examination





Credits
4

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events					
WT 22/23	2313739	Lighting Engineering	2 SWS	Lecture / 	Neumann
WT 22/23	2313741	Lighting Engineering (Tutorial to 2313739)	1 SWS	Practice	Neumann

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

Prerequisites

none

T

7.144 Course: Lightweight Engineering Design [T-MACH-105221]




Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Norbert Burkardt

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-102696 - Lightweight Engineering Design](#)

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

Events					
ST 2023	2146190	Lightweight Engineering Design	2 SWS	Lecture / 	Albers, Burkardt

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

Competence Certificate

Written examination (90 min)

Prerequisites

None



7.145 Course: Localization of Mobile Agents [T-INFO-101377]

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: [M-INFO-100840 - Localization of Mobile Agents](#)

Type
Oral examination

Credits
6

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1


Events					
ST 2023	24613	Localization of Mobile Agents	3 SWS	Lecture /	Zea Cobo, Cao




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

T

7.146 Course: Logistics and Supply Chain Management [T-MACH-110771]**Responsible:** Prof. Dr.-Ing. Kai Furmans**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105298 - Logistics and Supply Chain Management](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	9	Grade to a third	Each summer term	4

Events					
ST 2023	2118078	Logistics and Supply Chain Management	4 SWS	Lecture / 	Furmans, Alicke

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Competence Certificate**

The success control takes place in the form of an examination performance of a different kind. This is composed as follows:

- 50% assessment of a written examination (60 min) during the semester break
- 50% assessment of an oral examination (20 min) during the semester break

To pass the examination, both examination performances must be passed.

Prerequisites

None

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-102089 - Logistics - Organisation, Design and Control of Logistic Systems](#) must not have been started.

Annotation

The brick cannot be taken if one of the bricks "T-MACH-102089 – Logistics - Organisation, Design and Control of Logistic Systems" and "T-MACH-105181 – Supply Chain Management" has been taken.




T




7.147 Course: Machine Dynamics [T-MACH-105210]

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

Part of: [M-MACH-102694 - Machine Dynamics](#)

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

Events					
WT 22/23	2161224	Machine Dynamics	2 SWS	Lecture / 	Proppe
ST 2023	2161224	Machine Dynamics	2 SWS	Lecture / 	Proppe
ST 2023	2161225	Machine Dynamics (Tutorial)	1 SWS	Practice / 	Proppe, Fischer

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

Competence Certificate

written exam, 180 min.

Prerequisites

none



7.148 Course: Machine Learning - Foundations and Algorithms [T-INFO-111558]





Responsible: Prof. Dr. Gerhard Neumann

Organisation: KIT Department of Informatics

Part of: [M-INFO-105778 - Machine Learning - Foundations and Algorithms](#)

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

Events					
ST 2023	2400018	Machine Learning – Foundations and Algorithms	3 SWS	Lecture / Practice (/ )	Neumann

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

Competence Certificate

The success control takes place in the form of a written exam, usually 90 minutes in length, according to § 4 Abs. 2 Nr. 1 SPO.

A bonus can be acquired through successful participation in the exercise as a success control of a different kind (§4(2), 3 SPO 2008) or study performance (§4(3) SPO 2015). The exact criteria for awarding a bonus will be announced at the beginning of the lecture. If the grade of the written examination is between 4.0 and 1.3, the bonus improves the grade by one grade level (0.3 or 0.4). The bonus is only valid for the main and post exams of the semester in which it was earned. After that, the grade bonus expires.

Prerequisites

none.

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-WIWI-106340 - Machine Learning 1 - Basic Methods](#) must not have been started.
2. The course [T-INFO-110630 - Machine Learning - Basic Methods](#) must not have been started.

Recommendation



- Attendance of the lecture “Foundations of Artificial Intelligence” (“Grundlagen der Künstlichen Intelligence”)
- Knowledge in python
- Mathematics-heavy lecture. The basics will be reviewed, but mathematical proficiency is helpful





T

7.149 Course: Machine Learning 1 - Basic Methods [T-WIWI-106340]

Responsible: Prof. Dr.-Ing. Johann Marius Zöllner
Organisation: KIT Department of Economics and Management
Part of: [M-WIWI-105003 - Machine Learning 1](#)

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

Events					
WT 22/23	2511500	Machine Learning 1 - Fundamental Methods	2 SWS	Lecture / 	Zöllner
WT 22/23	2511501	Exercises to Machine Learning 1 - Fundamental Methods	1 SWS	Practice / 	Zöllner, Polley, Fechner, Daaboul

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

Competence Certificate

Depending on further pandemic developments, the exam will be offered either as an open-book exam, or as a written exam (60 min):

The exam takes place every semester and can be repeated at every regular examination date.

A grade bonus can be earned by successfully completing practice exercises. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by up to one grade level (0.3 or 0.4). Details will be announced in the lecture.

Prerequisites

None.



7.150 Course: Machine Learning 2 – Advanced Methods [T-WIWI-106341]

Responsible: Prof. Dr.-Ing. Johann Marius Zöllner
Organisation: KIT Department of Economics and Management
Part of: [M-WIWI-105006 - Machine Learning 2](#)

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

Events					
ST 2023	2511502	Machine Learning 2 - Advanced methods	2 SWS	Lecture /	Zöllner
ST 2023	2511503	Exercises for Machine Learning 2 - Advanced Methods	1 SWS	Practice /	Zöllner

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

Competence Certificate

Depending on further pandemic developments, the exam will be offered either as an open-book exam, or as a written exam (60 min).

The exam takes place every semester and can be repeated at every regular examination date.




Prerequisites

None.

T

7.151 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-105107 - Machine Tools and Industrial Handling](#)**Type**
Oral examination**Credits**
8**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1

Events					
WT 22/23	2149910	Machine Tools and High-Precision Manufacturing Systems	6 SWS	Lecture / Practice (/ )	Fleischer

Legend:  Online,  Blended (On-Site/Online),  On-Site, X 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.

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-110963 - Machine Tools and High-Precision Manufacturing Systems](#) must not have been started.

T

7.152 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-101923 - Machine Vision](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each winter term	2

Events					
WT 22/23	2137308	Machine Vision	4 SWS	Lecture / Practice (/ ●)	Lauer, Kinzig

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

Competence Certificate

Type of Examination: written exam

Duration of Examination: 60 minutes


Prerequisites





None

T**7.153 Course: Manufacturing Measurement Technology [T-ETIT-106057]**

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-103043 - Manufacturing Measurement Technology](#)

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

Events					
ST 2023	2302116	Fertigungsmesstechnik	2 SWS	Lecture / 	Heizmann

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

T

7.154 Course: Master's Thesis [T-ETIT-106463]

Responsible: Prof. Dr. Martin Doppelbauer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-103253 - Master's Thesis](#)

Type	Credits	Grading scale	Recurrence	Version
Final Thesis	30	Grade to a third	Each term	1

Final Thesis

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

Submission deadline 6 months


Maximum extension period 3 months




Correction period 8 weeks

This thesis requires confirmation by the examination office.

T

7.155 Course: Material Flow in Logistic Systems [T-MACH-102151]**Responsible:** Prof. Dr.-Ing. Kai Furmans**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-104984 - Material Flow in Logistic Systems](#)**Type**
Examination of another type**Credits**
9**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
3

Events					
WT 22/23	2117051	Material flow in logistic systems	15 SWS	Others (sons / )	Furmans, Fleischmann, Köhler

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Competence Certificate**

The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
 - 40% assessment of the result of the case studies as group work,
 - 20% assessment of the oral examination during the case study colloquiums as individual performance.

A detailed description of the learning control can be found under Annotations.

Prerequisites

none

Recommendation

Recommended elective subject: Probability Theory and Statistics


Annotation




Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. In the oral examination during the case study colloquiums, the understanding of the result of the group work and the models dealt with in the course is tested. The participation in the oral defenses is compulsory and will be controlled. For the written submission the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

T

7.156 Course: Materials of Lightweight Construction [T-MACH-105211]**Responsible:** Dr.-Ing. Wilfried Liebig**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-102727 - Materials for Lightweight Construction](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each summer term**Version**
1

Events					
ST 2023	2174574	Materials of Lightweight Construction	2 SWS	Lecture / 	Liebig

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Competence Certificate**

Oral exam, about 25 minutes

Prerequisites

none

Recommendation


Materials Science I/II





T**7.157 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-103205 - Engineering Mechanics](#)

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

Events					
WT 22/23	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.



7.158 Course: Measurement Technology [T-ETIT-112147]

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-105982 - Measurement Technology](#)

Type
Written examination

Credits
5

Grading scale
Grade to a third

Version
1

Events					
WT 22/23	2302117	Measurement Technology	2 SWS	Lecture /	Heizmann
WT 22/23	2302118	Exercise for 2302117 Measurement Technology	1 SWS	Practice /	Heizmann, Panther

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

Competence Certificate

The examination takes place in form of a written examination lasting 120 minutes. The module grade is the grade of the written examination.

Prerequisites

T-ETIT-101937 – Messtechnik (German version) must not have started.

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-ETIT-101937 - Measurement Technology](#) must not have been started.

T**7.159 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-102713 - Mechanics in Microtechnology](#)

Type
Oral examination





Credits
4

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events					
WT 22/23	2181710	Mechanics in Microtechnology	2 SWS	Lecture / 	Gruber, Greiner

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

Competence Certificate

Oral examination, ca. 30 min

Prerequisites





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T**7.160 Course: Mechano-Informatics and Robotics [T-INFO-101294]**

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [M-INFO-100757 - Mechano-Informatics and Robotics](#)

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

Events					
WT 22/23	2400077	Mechano-Informatics and Robotics	2 SWS	Lecture / 	Asfour

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



7.161 Course: Medical Imaging Techniques I [T-ETIT-101930]

Responsible: Prof. Dr. Maria Francesca Spadea
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100384 - Medical Imaging Techniques I](#)

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

Events					
WT 22/23	2305261	Medical Imaging Techniques I	2 SWS	Lecture	Spadea, Nahm, Loewe

Competence Certificate

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

Prerequisites

none





T

7.162 Course: Medical Imaging Techniques II [T-ETIT-101931]

Responsible: Prof. Dr. Maria Francesca Spadea
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100385 - Medical Imaging Techniques II](#)

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

Events					
ST 2023	2305262	Medical Imaging Techniques II	2 SWS	Lecture / 	Spadea

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

Competence Certificate

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

Prerequisites

none

Recommendation

The contents of the M-ETIT-100384 module are required.

T


7.163 Course: Methods and Processes of PGE - Product Generation Engineering [T-MACH-109192]





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

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-102718 - Product Development – Methods of Product Engineering](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1

Events					
ST 2023	2146176	Methods and Processes of PGE - Product Generation Engineering	4 SWS	Lecture / 	Albers

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

Competence Certificate

Written exam (processing time: 120 min + 10 min reading time)

Auxiliaries:

- Calculator
- German dictionary (books only)

Prerequisites

None

Annotation



This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.





T

7.164 Course: Methods of Signal Processing [T-ETIT-100694]

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100540 - Methods of Signal Processing](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 22/23	2302113	Methods of Signal Processing	2 SWS	Lecture / 	Heizmann
WT 22/23	2302115	Methods of Signal Processing (Tutorial to 2302113)	1+1 SWS	Practice / 	Heizmann, Diaz Ocampo

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

Prerequisites

none

**7.165 Course: Microactuators [T-MACH-101910]**

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

Part of: [M-MACH-100487 - Microactuators](#)

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

Competence Certificate

written exam, 60 min.

Prerequisites

none

T**7.166 Course: Microenergy Technologies [T-MACH-105557]****Responsible:** Prof. Dr. Manfred Kohl**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-102714 - Microenergy Technologies](#)

Type
Oral examination

Credits
4

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Competence Certificate

Oral examination (30 Min.)

Prerequisites

none

T**7.167 Course: Microsystem Simulation [T-MACH-108383]**

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

Part of: [M-MACH-105486 - Micro System Simulation](#)

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

Competence Certificate

written exam

Prerequisites

none



7.168 Course: Microsystem Technology [T-ETIT-100752]

Responsible: Prof. Dr. Wilhelm Stork
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100454 - Microsystem Technology](#)

Type
Oral examination

Credits
3

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events

WT 22/23	2311625	Microsystem Technology	2 SWS	Lecture /	Stork
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate

Achievement will be examined in an oral examination (approx. 20 minutes).

Prerequisites

none



7.169 Course: Microwave Engineering [T-ETIT-100802]

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100535 - Microwave Engineering](#)

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

Events					
WT 22/23	2308407	Microwave Engineering	2 SWS	Lecture /	Pauli
WT 22/23	2308409	Tutorial for 2308407 Microwave Engineering	1 SWS	Practice /	Bhutani
ST 2023	2308407	Microwave Engineering	2 SWS	Lecture /	Pauli
ST 2023	2308409	Tutorial for 2308407 Microwave Engineering	1 SWS	Practice /	Nuß

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

Prerequisites

none

Annotation

WS: german

SS: english



The exam is in each semester and for every student bilingual.





T

7.170 Course: Microwave Engineering Lab [T-ETIT-110789]

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-105300 - Microwave Engineering Lab](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	1

Events					
WT 22/23	2308415	Microwave Engineering Lab	4 SWS	Practical course / 	Pauli
ST 2023	2308415	Microwave Engineering Lab	4 SWS	Practical course / 	Pauli

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

Competence Certificate

To prepare the laboratory tests, each laboratory group has to do some homework together before the experiment and hand in a simple copy to the supervisor immediately before the start of the experiment. The tasks for the experiment as such are processed and logged during the implementation. The protocol should be handed over to the supervisor immediately after the experiment has been carried out. Before each experiment, there is a written exam or oral (approx. 20 min., No aids) the content of the experiment.

Prerequisites

none

Recommendation

Knowledge of microwave measurement technology and RF components and systems is helpful.

T

7.171 Course: Microwaves Measurement Techniques [T-ETIT-100733]

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100424 - Microwaves Measurement Techniques](#)



Type
Oral examination





Credits
4

Grading scale
Grade to a third

Recurrence
Each summer term

Version
4

Events					
ST 2023	2308420	Microwaves Measurement Techniques	2 SWS	Lecture / 	Pauli, Ruess
ST 2023	2308422	Übungen zu 2308420 Mikrowellenmesstechnik	1 SWS	Practice / 	Pauli, Ruess

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

Prerequisites

none

T



7.172 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-105308 - Modern Control Concepts I](#)

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

Events					
ST 2023	2105024	Modern Control Concepts I	2 SWS	Lecture / 	Matthes, Groell
ST 2023	2106020	Tutorial on Modern Control Concepts I	2 SWS	Practice / 	Matthes

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


Competence Certificate





Written exam (Duration: 1 h)

Prerequisites

none

T**7.173 Course: Modern Control Concepts II [T-MACH-106691]****Responsible:** apl. Prof. Dr. Lutz Groell**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105313 - Modern Control Concepts II](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1**Events**

WT 22/23	2106032	Modern Control Concepts II	2 SWS	Lecture / 	Groell
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Competence Certificate**

oral exam (Duration: 30min)





Prerequisites

none

T

7.174 Course: Modern Control Concepts III [T-MACH-106692]**Responsible:** apl. Prof. Dr. Lutz Groell**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105314 - Modern Control Concepts III](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each summer term**Version**
1**Events**

ST 2023	2106035	Modern Control Concepts III	2 SWS	Lecture / 	Groell
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Competence Certificate**

oral exam (Duration: 30min)

Prerequisites

none

T

7.175 Course: Modern Radio Systems Engineering [T-ETIT-100735]

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100427 - Modern Radio Systems Engineering](#)



Type
Oral examination





Credits
4

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events					
ST 2023	2308430	Modern Radio Systems Engineering	2 SWS	Lecture / 	Bhutani
ST 2023	2308431	Tutorial 2308430 Modern Radio Systems Engineering	1 SWS	Practice / 	Bhutani


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





Prerequisites

none

T**7.176 Course: Motion in Human and Machine - Seminar [T-INFO-105140]****Responsible:** Prof. Dr.-Ing. Tamim Asfour**Organisation:** KIT Department of Informatics**Part of:** [M-INFO-102555 - Motion in Human and Machine - Seminar](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each summer term	2

Events					
ST 2023	2400063	Motion in Human and Machine	3 SWS	Seminar / 	Asfour

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

The assessment is carried out as an examination of another type (§ 4 Abs. 2 No. 3 SPO). It includes a term paper and a final presentation.

Prerequisites

none.

Recommendation

Programming experience in C++, Python or Matlab is recommended.



Attending the lectures Robotics I – Introduction to Robotics, Robotics II: Humanoid Robotics, Robotics III - Sensors and Perception in Robotics, Mechano-Informatics and Robotics and Wearable Robotic Technologies is recommended.



Annotation

The block practical course is an interdisciplinary event in cooperation with the University of Stuttgart, University of Tübingen and the Hertie Institute for Clinical Brain Research; Centre for Integrative Neuroscience in Tübingen.

T

7.177 Course: Motor Vehicle Labor [T-MACH-105222]**Responsible:** Dr.-Ing. Michael Frey**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-102695 - Motor Vehicle Laboratory](#)**Type**
Written examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each term**Version**
3

Events					
WT 22/23	2115808	Motor Vehicle Laboratory	2 SWS	Practical course / 	Frey
ST 2023	2115808	Motor Vehicle Laboratory	2 SWS	Practical course / 	Frey

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Competence Certificate**

Colloquium before each experiment

After completion of the experiments: written examination

Duration: 90 minutes

Auxiliary means: none



Prerequisites





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T

7.178 Course: Nano- and Quantum Electronics [T-ETIT-111232]

Responsible: Prof. Dr. Sebastian Kempf**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-105604 - Nano- and Quantum Electronics](#)**Type**
Written examination**Credits**
6**Grading scale**
Grade to a third**Recurrence**
Each summer term**Expansion**
1 terms**Version**
1

Events					
ST 2023	2312668	Nano- and Quantum Electronics	3 SWS	Lecture / 	Kempf
ST 2023	2312670	Tutorial for 2312668 Nano- and Quantum Electronics	1 SWS	Practice / 	Wünsch

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

The assessment of success takes place in the form of a written examination lasting 120min. The grade corresponds to the result of the written examination.

Prerequisites

none

Modeled Conditions

The following conditions have to be fulfilled:


1. The course [T-ETIT-100971 - Nanoelectronics](#) must not have been started.





Recommendation

Successful completion of the modules "Superconductivity for Engineers" and „Einführung in die Quantentheorie für Elektrotechniker“ is recommended.

T**7.179 Course: Nonlinear Control Systems [T-ETIT-100980]****Responsible:** Dr.-Ing. Mathias Kluwe**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100371 - Nonlinear Control Systems](#)

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

Events					
ST 2023	2303173	Nichtlineare Regelungssysteme	2 SWS	Lecture / 	Kluwe

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

none



7.180 Course: Nonlinear Optics [T-ETIT-101906]

Responsible: Prof. Dr.-Ing. Christian Koos
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100430 - Nonlinear Optics](#)

Type
Oral examination

Credits
6

Grading scale
Grade to a third

Recurrence
Each summer term

Version
2

Events					
ST 2023	2309468	Nonlinear Optics	2 SWS	Lecture /	Koos
ST 2023	2309469	Nonlinear Optics (Tutorial)	2 SWS	Practice /	Koos

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

Prerequisites

none

T

7.181 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-105292 - Novel Actuators and Sensors](#)

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

Events					
WT 22/23	2141865	Novel actuators and sensors	2 SWS	Lecture / 	Kohl, Sommer

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

Competence Certificate

written exam, 60 minutes

Prerequisites

none

T

7.182 Course: Numerical Methods - Exam [T-MATH-111700]

Responsible: apl. Prof. Dr. Peer Kunstmann
 Prof. Dr. Michael Plum
 Prof. Dr. Wolfgang Reichel

Organisation: KIT Department of Mathematics

Part of: [M-MATH-105831 - Numerical Methods](#)

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

Events					
ST 2023	0180300	Numerical Methods (Electrical Engineering, Meteorology, Remote Sensing, Geoinformatics)	2 SWS	Lecture	Plum

Competence Certificate

Success control takes the form of a written examination (120 minutes).

Prerequisites

none





T

7.183 Course: Optical Communications Laboratory [T-ETIT-100742]

Responsible: Prof. Dr.-Ing. Christian Koos
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100437 - Optical Communicatons Laboratory](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each summer term	1

Events					
ST 2023	2309490	Photonics and Communications Lab	4 SWS	Practical course / 	Koos, Freude, Randel

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

Prerequisites

none



7.184 Course: Optical Design Lab [T-ETIT-100756]

Responsible: Prof. Dr. Wilhelm Stork
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100464 - Optical Design Lab](#)


Type
Oral examination





Credits
6

Grading scale
Grade to a third

Recurrence
Each summer term

Version
2

Events					
ST 2023	2311647	Optical Design Lab	4 SWS	Practical course / 	Stork



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





Prerequisites

none

T

7.185 Course: Optical Transmitters and Receivers [T-ETIT-100639]**Responsible:** Prof. Dr. Wolfgang Freude**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100436 - Optical Transmitters and Receivers](#)**Type**
Oral examination**Credits**
6**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
2

Events					
WT 22/23	2309460	Optical Transmitters and Receivers	2 SWS	Lecture / 	Freude, Bremauer, Fang
WT 22/23	2309461	Tutorial for 2309460 Optical Transmitters and Receivers	2 SWS	Practice / 	Freude, N.N.

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

none



7.186 Course: Optical Waveguides and Fibers [T-ETIT-101945]

Responsible: Prof. Dr.-Ing. Christian Koos
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100506 - Optical Waveguides and Fibers](#)

Type
Oral examination

Credits
4

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events					
WT 22/23	2309464	Optical Waveguides and Fibers	2 SWS	Lecture /	Koos, N.N., Bao, Drayß
WT 22/23	2309465	Tutorial for 2309464 Optical Waveguides and Fibers	1 SWS	Practice /	Koos, N.N.

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

Prerequisites

none

T**7.187 Course: Optimal Control and Estimation [T-ETIT-104594]**

Responsible: Prof. Dr.-Ing. Sören Hohmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-102310 - Optimal Control and Estimation](#)

Type
Oral examination

Credits
3





Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events

ST 2023	2303162	Optimale Regelung und Schätzung	2 SWS	Lecture / 	Kluwe
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

Prerequisites




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

T

7.188 Course: Optimization of Dynamic Systems [T-ETIT-100685]

Responsible: Prof. Dr.-Ing. Sören Hohmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100531 - Optimization of Dynamic Systems](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Each winter term	1

Events					
WT 22/23	2303183	Optimization of Dynamic Systems	2 SWS	Lecture / 	Hohmann
WT 22/23	2303185	Optimization of Dynamic Systems (Tutorial to 2303183)	1 SWS	Practice / 	Bohn
WT 22/23	2303851	Accompanying group tutorial for 2303183 Optimization of Dynamic Systems	1 SWS	Tutorial (/ 	Bohn

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

Competence Certificate

The assessment consists of a written exam (120 min) taking place in the recess period.

Prerequisites

none



7.189 Course: Optoelectronic Measurement Engineering [T-ETIT-100771]

Responsible: Dr.-Ing. Klaus Trampert

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-100484 - Optoelectronic Measurement Engineering](#)

Type
Oral examination

Credits
3

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events					
ST 2023	2313736	Optoelectronic Measurement Engineering	2 SWS	Lecture /	Trampert

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

Prerequisites


none





T

7.190 Course: Optoelectronics [T-ETIT-100767]

Responsible: Prof. Dr. Ulrich Lemmer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100480 - Optoelectronics](#)

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

Events					
WT 22/23	2313726	Optoelectronics	2 SWS	Lecture / 	Lemmer
WT 22/23	2313728	Übungen zu 2313726 Optoelektronik	1 SWS	Practice	Lemmer

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

Competence Certificate

The success check is carried out in the context of a written exam (90 minutes).

Prerequisites

none

Recommendation

Knowledge of solid state electronics

T**7.191 Course: Oral Exam - Supplementary Studies on Culture and Society [T-ZAK-112659]**

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: [M-ZAK-106235 - Supplementary Studies on Culture and Society](#)

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

Competence Certificate

An oral examination according to § 7 section 6 of approx. 45 minutes on the contents of two courses from In-depth Module.

Prerequisites

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

T**7.192 Course: Oral Exam - Supplementary Studies on Sustainable Development [T-ZAK-112351]****Organisation:****Part of:** [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

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

Competence Certificate

An oral examination according to § 7 section 6 of approx. 45 minutes on the contents of two courses from Elective Module.


Prerequisites





A requirement for the Supplementary Course: Oral examination is the successful completion of the modules Basics Module and Specialisation Module and the required electives of Elective Module.

T

7.193 Course: Organ Support Systems [T-MACH-105228]**Responsible:** apl. Prof. Dr. Christian Pylatiuk**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-102702 - Organ Support Systems](#)

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

Events					
ST 2023	2106008	Organ support systems	2 SWS	Lecture / 	Pylatiuk

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

Written examination (Duration: 45min)

Prerequisites

none




7.194 Course: Pattern Recognition [T-INFO-101362]




Responsible: Prof. Dr.-Ing. Jürgen Beyerer
Tim Zander

Organisation: KIT Department of Informatics

Part of: [M-INFO-100825 - Pattern Recognition](#)

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

Events					
ST 2023	24675	Pattern Recognition	4 SWS	Lecture / Practice (/ )	Beyerer

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





T

7.195 Course: Photovoltaics [T-ETIT-101939]

Responsible: Prof. Dr.-Ing. Michael Powalla
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100513 - Photovoltaics](#)

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

Events					
ST 2023	2313737	Photovoltaics	3 SWS	Lecture / 	Powalla, Lemmer
ST 2023	2313738	Tutorial 2313737 Photovoltaik	1 SWS	Practice / 	Powalla, Lemmer

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

Prerequisites

"M-ETIT-100524 - Solar Energy" must not have started.

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-ETIT-100774 - Solar Energy](#) must not have been started.

T

7.196 Course: Physical and Data-Based Modelling [T-ETIT-111013]

Responsible: Prof. Dr.-Ing. Sören Hohmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-105468 - Physical and Data-Based Modelling](#)



Type
Oral examination





Credits
6

Grading scale
Grade to a third

Recurrence
Each summer term

Version
2

Events					
ST 2023	2303166	Physical and Data-Based Modelling	3 SWS	Lecture / 	Hohmann
ST 2023	2303167	Tutorial for zu 2303166 Physical and Data-Based Modelling	1 SWS	Practice / 	Gießler

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

Competence Certificate

Oral examination of approximately 20 minutes.

Prerequisites



none





T

7.197 Course: Physiology and Anatomy for Biomedical Engineering [T-ETIT-111815]

Responsible: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-105874 - Physiology and Anatomy for Biomedical Engineering](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 22/23	2305281	Physiology and Anatomy for Engineers I	2 SWS	Lecture / 	Nahm
ST 2023	2305282	Physiology and Anatomy for Engineers II	2 SWS	Lecture / 	Nahm

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

Competence Certificate

The examination is carried out in the form of a written test of 120 minutes.

The examination includes the contents of Physiologie und Anatomie I (offered every winter term) and Physiologie und Anatomie II (offered every summer term).

Prerequisites

The courses "T-ETIT-101932 - Physiologie und Anatomie I" und "T-ETIT-101933 - Physiologie und Anatomie II" must not have been started.

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-ETIT-101932 - Physiology and Anatomy for Engineers I](#) must not have been started.
2. The course [T-ETIT-101933 - Physiology and Anatomy for Engineers II](#) must not have been started.

Annotation**Winter/summer term:**

WT: Physiologie und Anatomie I

ST: Physiologie und Anatomie II



7.198 Course: Plasma Sources [T-ETIT-100768]

Responsible: Prof. Dr. Wolfgang Heering
Dr.-Ing. Rainer Kling

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-100481 - Plasma Sources](#)

Type
Oral examination

Credits
4

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events

WT 22/23	2313729	Plasma Sources	3 SWS	Lecture /	Kling
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled





Prerequisites

none

T

7.199 Course: Plastic Electronics / Polymerelectronics [T-ETIT-100763]**Responsible:** Prof. Dr. Ulrich Lemmer**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100475 - Plastic Electronics / Polymerelectronics](#)**Type**
Oral examination**Credits**
3**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1**Events**

WT 22/23	2313709	Polymerelectronics/ Plastic Electronics	2 SWS	Lecture / 	Lemmer
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Competence Certificate**

oral exam (approx. 20 minutes)





Prerequisites

none

T

7.200 Course: PLM for Product Development in Mechatronics [T-MACH-102181]**Responsible:** Prof. Dr.-Ing. Martin Eigner**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-101283 - Virtual Engineering A](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each summer term**Version**
2

Events					
WT 22/23	2122376	PLM for product development in mechatronics	2 SWS	Lecture / 	Eigner
ST 2023	2122376	PLM for product development in mechatronics	2 SWS	Lecture / 	Eigner

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

Oral examination 20 min.


Prerequisites




none

T

7.201 Course: Plug-and-Play Material Handling [T-MACH-106693]**Responsible:** Prof. Dr.-Ing. Kai Furmans**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-104983 - Plug-and-Play Material Handling](#)

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

Events					
WT 22/23	2117070	Plug-and-play material handling	2 SWS	Practical course / 	Furmans, Müller, Enke

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Competence Certificate**

Presentation of the four steps of the course content (design, implementation, test concept and evaluation)

Prerequisites

None

T



7.202 Course: Power Electronic Systems in Energy Technology [T-ETIT-112286]**Responsible:** Prof. Dr.-Ing. Marc Hiller**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-106067 - Power Electronic Systems in Energy Technology](#)





Type
Oral examination

Credits
6

Grading scale
Grade to a third

Version
1

Events					
WT 22/23	2306357	Power Electronic Systems in Energy applications	3 SWS	Lecture / 	Hiller
WT 22/23	2306358	Power Electronic Systems in Energy applications	1 SWS	Practice / 	Hiller

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

Prerequisites

none

T

7.203 Course: Power Electronics [T-ETIT-109360]

Responsible: Prof. Dr.-Ing. Marc Hiller
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-104567 - Power Electronics](#)

Type
Written examination

Credits
6

Grading scale
Grade to a third

Recurrence
Each summer term

Expansion
1 terms

Version
6

Events					
ST 2023	2300004	Ausweich- und Praktikumstermin für ETI-Vorlesungen	2 SWS	Practical course / 	Hiller, Frank
ST 2023	2306323	Power Electronics	2 SWS	Lecture / 	Hiller
ST 2023	2306324	Tutorial for 2306385 Power Electronics	2 SWS	Practice / 	Hiller, Frank

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

Competence Certificate

The examination takes place in form of a written examination lasting 120 minutes.

Prerequisites

none

T**7.204 Course: Power Electronics for Photovoltaics and Wind Energy [T-ETIT-104569]**

Responsible: Prof. Dr.-Ing. Marc Hiller
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-102261 - Power Electronics for Photovoltaics and Wind Energy](#)

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

Events					
WT 22/23	2306347	Power Electronics for Photovoltaics and Wind Energy	2 SWS	Lecture	Burger
ST 2023	2306347	Power Electronics for Photovoltaics and Wind Energy	2 SWS	Lecture	Burger

Prerequisites
 none



7.205 Course: Power Network [T-ETIT-100830]

Responsible: Prof. Dr.-Ing. Thomas Leibfried
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100572 - Power Network](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 22/23	2307371	Power Network	2 SWS	Lecture /	Leibfried
WT 22/23	2307373	Tutorial for 2307371 Power Network	2 SWS	Practice /	Leibfried, Geis-Schroer

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



7.206 Course: Power Systems and Economy [T-ETIT-100725]

Responsible: Dr.-Ing. Bernd Hoferer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100413 - Power Systems and Economy](#)

Type
Oral examination

Credits
3

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events

WT 22/23	2307383	Power Systems and Economy	2 SWS	Lecture /	Weissmüller
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Prerequisites



none





T

7.207 Course: Power Transmission and Power Network Control [T-ETIT-101941]

Responsible: Prof. Dr.-Ing. Thomas Leibfried
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100534 - Power Transmission and Power Network Control](#)

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

Events					
ST 2023	2307372	Power Transmission and Power Network Control	2 SWS	Lecture / 	Leibfried
ST 2023	2307374	Übungen zu 2307372 Energieübertragung und Netzregelung	1 SWS	Practice / 	Bisseling

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

Prerequisites



none





T

7.208 Course: Practical Aspects of Electrical Drives [T-ETIT-100711]

Responsible: Prof. Dr. Martin Doppelbauer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100394 - Practical Aspects of Electrical Drives](#)

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

Events					
ST 2023	2306311	Practical Aspects of Electrical Drives	2 SWS	Lecture / 	Doppelbauer
ST 2023	2306313	Übungen zu 2306311 Praxis elektrischer Antriebe	1 SWS	Practice / 	Doppelbauer

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

Prerequisites

none


T**7.209 Course: Practical Course: Machine Learning and Intelligent Systems [T-INFO-112104]**





Responsible: Michael Fennel
Prof. Dr.-Ing. Uwe Hanebeck

Organisation: KIT Department of Informatics

Part of: [M-INFO-105958 - Practical Course: Machine Learning and Intelligent Systems](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each term	1

Events					
ST 2023	24871	Practical Course Machine Learning and Intelligent Systems	4 SWS	Practical course / 	Hanebeck, Fennel

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

Modeled Conditions



The following conditions have to be fulfilled:





1. The course [T-INFO-105278 - Practical Course Research Project: Hands-on Anthropomatics](#) must not have been started.

T

7.210 Course: Practical Course: Smart Energy System Lab [T-INFO-112030]**Responsible:** Dr.-Ing. Simon Waczowicz**Organisation:** KIT Department of Informatics**Part of:** [M-INFO-105955 - Practical Course: Smart Energy System Lab](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	1

Events					
WT 22/23	2400159	Laboratory: Smart Energy System Lab	4 SWS	Practical course / 	Hagenmeyer, Waczowicz, Süß, Turowski
ST 2023	2400082	Laboratory: Smart Energy System Lab	2 SWS	Practical course / 	Hagenmeyer, Waczowicz, Süß, Turowski

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

T**7.211 Course: Practical Project Robotics and Automation I (Software) [T-INFO-104545]**

Responsible: Prof. Dr.-Ing. Björn Hein
Prof. Dr.-Ing. Thomas Längle

Organisation: KIT Department of Informatics

Part of: [M-INFO-102224 - Practical Project Robotics and Automation I \(Software\)](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	1

Events					
WT 22/23	24282	Project practical Robotics and Automation I (Software)	4 SWS	Practical course	Hein, Längle

Modeled Conditions

You have to fulfill one of 2 conditions:

1. The course [T-INFO-105107 - Robotics - Practical Course](#) must not have been started.
2. The course [T-INFO-104552 - Practical Project Robotics and Automation II \(Hardware\)](#) must not have been started.

T

7.212 Course: Practical Project Robotics and Automation II (Hardware) [T-INFO-104552]

Responsible: Prof. Dr.-Ing. Björn Hein
Prof. Dr.-Ing. Thomas Längle

Organisation: KIT Department of Informatics

Part of: [M-INFO-102230 - Practical Project Robotics and Automation II \(Hardware\)](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each term	1

Events					
WT 22/23	24290	Robotics and Automation II (Hardware)	4 SWS	Practical course	Hein, Längle





Modeled Conditions





You have to fulfill one of 2 conditions:

1. The course [T-INFO-105107 - Robotics - Practical Course](#) must not have been started.
2. The course [T-INFO-104545 - Practical Project Robotics and Automation I \(Software\)](#) must not have been started.

T**7.213 Course: Practical Training in Basics of Microsystem Technology [T-MACH-102164]****Responsible:** Dr. Arndt Last**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105479 - Practical Training in Basics of Microsystem Technology](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each term	1

Events					
WT 22/23	2143875	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course / 	Last
WT 22/23	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course / 	Last
ST 2023	2143875	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course / 	Last
ST 2023	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course / 	Last

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

The assessment consists of a written exam

Prerequisites

none

T**7.214 Course: Practice Module [T-ZAK-112660]**

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: [M-ZAK-106235 - Supplementary Studies on Culture and Society](#)

Type	Credits	Grading scale	Version
Completed coursework	4	pass/fail	1

Competence Certificate

Internship (3 ECT)

Report within the framework of the practical training (Length approx. 18,000 characters (incl. spaces)
(1 ECT)

Prerequisites

none


Annotation




Knowledge from the Basic Module and the Elective Module is helpful.

T

7.215 Course: Principles of Medicine for Engineers [T-MACH-105235]**Responsible:** apl. Prof. Dr. Christian Pylatiuk**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-102720 - Principles of Medicine for Engineers](#)

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

Events					
WT 22/23	2105992	Principles of Medicine for Engineers	2 SWS	Lecture / 	Pylatiuk

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Competence Certificate**

Written examination (Duration: 45min)

Prerequisites

none

T


7.216 Course: Production Techniques Laboratory [T-MACH-105346]





Responsible: Prof. Dr.-Ing. Barbara Deml
 Prof. Dr.-Ing. Jürgen Fleischer
 Prof. Dr.-Ing. Kai Furmans
 Prof. Dr.-Ing. Jivka Ovtcharova

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-102711 - Production Techniques Laboratory](#)

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

Events					
ST 2023	2110678	Production Techniques Laboratory	4 SWS	Practical course / 	Deml, Fleischer, Furmans, Ovtcharova

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

Competence Certificate

Advanced Internship: Participate in practice exercise courses and complete the colloquia successfully.

Elective Subject: Participate in practice exercise courses and complete the colloquia successfully and presentation of a specific topic.

Prerequisites

None

T

7.217 Course: Project Management in the Development of Products for Safety-Critical Applications [T-ETIT-109148]

Responsible: Dr.-Ing. Manfred Nolle

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-104475 - Project Management in the Development of Products for Safety-Critical Applications](#)

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

Events					
WT 22/23	2311641	Project Management in the Development of Products for Safety-Critical Applications	2 SWS	/ ☞	Nolle
WT 22/23	2311643	Tutorial for 2311641 Project Management in the Development of Products for Safety-Critical Applications	1 SWS	Practice / ☞	Nolle

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





T**7.218 Course: ProVIL - Product Development in a Virtual Idea Laboratory [T-MACH-106738]**

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

Part of: [M-ETIT-103248 - Key Competences](#)

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

Events					
ST 2023	2146210	ProVIL - Product Development in a Virtual Idea Laboratory	3 SWS	Lecture / 	Albers, Albers Assistenten

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

Competence Certificate
 colloquia and presentations.


Prerequisites
 none





T

7.219 Course: Quality Management [T-MACH-102107]

Responsible: Prof. Dr.-Ing. Gisela Lanza**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105332 - Quality Management](#)

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

Events					
WT 22/23	2149667	Quality Management	2 SWS	Lecture / 	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].

T

7.220 Course: Rail System Technology [T-MACH-106424]**Responsible:** Prof. Dr.-Ing. Martin Cichon**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-103232 - Rail System Technology](#)

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

Events					
WT 22/23	2115919	Rail System Technology	2 SWS	Lecture / 	Heckele, Gratzfeld
ST 2023	2115919	Rail System Technology	2 SWS	Lecture / 	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

T

7.221 Course: Rail Vehicle Technology [T-MACH-105353]**Responsible:** Prof. Dr.-Ing. Martin Cichon**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-102683 - Rail Vehicle Technology](#)

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

Events					
WT 22/23	2115996	Rail Vehicle Technology	2 SWS	Lecture / 	Reimann, Gratzfeld
ST 2023	2115996	Rail Vehicle Technology	2 SWS	Lecture / 	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

T



7.222 Course: Real Time Control of Electrical Drives [T-ETIT-111898]**Responsible:** Dr.-Ing. Andreas Liske**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-105916 - Real Time Control of Electrical Drives](#)





Type
Oral examination

Credits
6

Grading scale
Grade to a third

Version
1

Events					
WT 22/23	2306353	Real Time Control of Electrical Drives	3 SWS	Lecture / 	Liske
WT 22/23	2306354	Tutorial for 2306353 Real Time Control of Electrical Drives	1 SWS	Practice / 	Liske


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







7.223 Course: Real-Time Systems [T-INFO-101340]

Responsible: Prof. Dr.-Ing. Thomas Längle
Organisation: KIT Department of Informatics
Part of: [M-INFO-100803 - Real-Time Systems](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1

Events					
ST 2023	24576	Real-Time Systems	4 SWS	Lecture / Practice (/ )	Längle, Ledermann

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

T

7.224 Course: Reinforcement Learning [T-INFO-111255]

Responsible: Prof. Dr. Gerhard Neumann
Organisation: KIT Department of Informatics
Part of: [M-INFO-105623 - Reinforcement Learning](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Irregular	1

Events					
WT 22/23	2400163	Reinforcement Learning	SWS: 3 / ECTS: 5 SWS	Lecture / Practice (/ ●)	Neumann

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

Competence Certificate

The success control takes place in the form of a written exam, usually 90 minutes in length, according to § 4 Abs. 2 Nr. 1 SPO.

A bonus can be acquired through successful participation in the exercise as a success control of a different kind (§4(2), 3 SPO 2008) or study performance (§4(3) SPO 2015). The exact criteria for awarding a bonus will be announced at the beginning of the lecture. If the grade of the written examination is between 4.0 and 1.3, the bonus improves the grade by one grade level (0.3 or 0.4). The bonus is only valid for the main and post exams of the semester in which it was earned. After that, the grade bonus expires.

Prerequisites

none



Recommendation





- Students should be familiar with the content of the "Foundations of Artificial Intelligence" lecture.
- Good Python knowledge is required.
- Good mathematical background knowledge is required.

T

7.225 Course: Reliability and Test Engineering [T-MACH-111840]**Responsible:** Dr.-Ing. Thomas Gwosch**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-106050 - Reliability and Test Engineering](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	5	Grade to a third	Each winter term	1 terms	1

Events					
WT 22/23	2145350	Reliability and Test Engineering (Lecture)	2 SWS	Lecture / 	Gwosch
WT 22/23	2145351	Workshop Reliability and Test Engineering	2 SWS	Practical course / 	Gwosch

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

The grade is composed of the evaluation of a final report following the practical part. The assessment criteria are as follows:

- Structure of the report
- Comprehensibility and comprehensibility
- Preparation of the tests
- Use of test and reliability methods
- Formulation and answering of test hypotheses
- Test evaluation, comprehensible results

Attendance and active participation in the lab is mandatory.

Prerequisites

none





Recommendation

We strongly recommend the attendance of the MSuP lectures. Students who have not (yet) attended are recommended to learn the contents in advance.

T**7.226 Course: Renewable Energy-Resources, Technologies and Economics [T-WIWI-100806]****Responsible:** PD Dr. Patrick Jochem**Organisation:** KIT Department of Economics and Management**Part of:** [M-WIWI-100500 - Renewable Energy-Resources, Technologies and Economics](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	5

Events					
WT 22/23	2581012	Renewable Energy – Resources, Technologies and Economics	2 SWS	Lecture / 	Jochem

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

The assessment consists of a written exam (60 minutes, in English, answers are possible in German or English) (following §4(2) of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date. Depending on the respective pandemic situation, the exam may be offered as an open book exam (alternative exam assessment, following §4(2), 3 of the examination regulation).

Prerequisites

None.





T

7.227 Course: Robotics - Practical Course [T-INFO-105107]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [M-INFO-102522 - Robotics - Practical Course](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each summer term	2

Events					
ST 2023	24870	Robotics - Practical Course	4 SWS	Practical course / 	Asfour

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

Competence Certificate

The assessment is carried out as an examination of another type (§ 4 Abs. 2 No. 3 SPO). It is composed of several sub-tasks.

Prerequisites

Knowledge of the programming language C++ is required.

Modeled Conditions

You have to fulfill one of 2 conditions:

1. The course [T-INFO-104545 - Practical Project Robotics and Automation I \(Software\)](#) must not have been started.
2. The course [T-INFO-104552 - Practical Project Robotics and Automation II \(Hardware\)](#) must not have been started.

Recommendation


Attending the lectures Robotics I – Introduction to Robotics, Robotics II: Humanoid Robotics, Robotics III - Sensors and Perception in Robotics and Mechano-Informatics and Robotics is recommended.





T

7.228 Course: Robotics I - Introduction to Robotics [T-INFO-108014]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [M-INFO-100893 - Robotics I - Introduction to Robotics](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 22/23	2424152	Robotics I - Introduction to Robotics	3/1 SWS	Lecture / 	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 60 minutes.

Prerequisites

none.

Recommendation

none.





T

7.229 Course: Robotics II - Humanoid Robotics [T-INFO-105723]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [M-INFO-102756 - Robotics II - Humanoid Robotics](#)

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

Events					
ST 2023	2400074	Robotics II: Humanoid Robotics	2 SWS	Lecture / 	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 60 minutes.

Recommendation

Attending the lectures Robotics I – Introduction to Robotics and Mechano-Informatics and Robotics is recommended.





T

7.230 Course: Robotics III - Sensors and Perception in Robotics [T-INFO-109931]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: [M-INFO-104897 - Robotics III - Sensors and Perception in Robotics](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	2

Events					
ST 2023	2400067	Robotics III - Sensors and Perception in Robotics	2 SWS	Lecture / 	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 60 minutes.

Prerequisites

none.

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-INFO-101352 - Robotics III - Sensors in Robotics](#) must not have been started.

Recommendation

Attending the lecture Robotics I – Introduction to Robotics is recommended.

T

7.231 Course: Seamless Engineering [T-MACH-111401]





Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Eric Sax

Organisation: KIT Department of Electrical Engineering and Information Technology
KIT Department of Mechanical Engineering

Part of: [M-MACH-105725 - Seamless Engineering](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	9	Grade to a third	Each winter term	1

Events					
WT 22/23	2117072	Seamless Engineering - Logistics Robotics Workshop	2 SWS	Lecture / Practice (/ )	Furmans, Sax

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

Competence Certificate

The assessment of success takes place in the form of a written examination as well as an examination performance of another kind.

The overall grade is composed as follows:

- 50% assessment of an examination as individual performance as the conclusion of the lecture block.
- 50% assessment of colloquia as individual performance on defined milestones during the project work

Prerequisites

None

Recommendation

None

Annotation

The course consists of two components. Theoretical knowledge and basics about structured system design are taught in lecture and exercise. In parallel, a practical part takes place throughout the semester. In this, the students design and implement a mechatronic system in small groups using industry-related hardware and software to deal with a given task in the logistics environment.

T

7.232 Course: Self Assignment-HOC-SPZ-ZAK-graded [T-ETIT-111527]**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)

Type	Credits	Grading scale	Version
Examination of another type	2	Grade to a third	1

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

Annotation

Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the "Sprachenzentrum" or the Center for Applied Cultural Studies and Studium Generale.

Title and credits of the achievement are adopted.

T**7.233 Course: Self Assignment-HOC-SPZ-ZAK-graded [T-ETIT-111526]****Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)

Type	Credits	Grading scale	Version
Examination of another type	2	Grade to a third	1

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

Annotation

Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the "Sprachenzentrum" or the Center for Applied Cultural Studies and Studium Generale.

Title and credits of the achievement are adopted.

T**7.234 Course: Self Assignment-HOC-SPZ-ZAK-graded [T-ETIT-111528]****Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)

Type	Credits	Grading scale	Version
Examination of another type	2	Grade to a third	1

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

Annotation

Placeholder for self-booking of a graded interdisciplinary qualification, which was provided at the House of Competence, the "Sprachenzentrum" or the Center for Applied Cultural Studies and Studium Generale.

Title and credits of the achievement are adopted.

T**7.235 Course: Self Assignment-HOC-SPZ-ZAK-ungraded [T-ETIT-111531]****Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	1

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

Annotation

Placeholder for self-booking of a ungraded interdisciplinary qualification, which was provided at the House of Competence, the "Sprachenzentrum" or the Center for Applied Cultural Studies and Studium Generale.

Title and credits of the achievement are adopted.

T**7.236 Course: Self Assignment-HOC-SPZ-ZAK-ungraded [T-ETIT-111530]****Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	1

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

Annotation

Placeholder for self-booking of a ungraded interdisciplinary qualification, which was provided at the House of Competence, the "Sprachenzentrum" or the Center for Applied Cultural Studies and Studium Generale.

Title and credits of the achievement are adopted.

T**7.237 Course: Self Assignment-HOC-SPZ-ZAK-ungraded [T-ETIT-111532]****Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	1

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

Annotation

Placeholder for self-booking of a ungraded interdisciplinary qualification, which was provided at the House of Competence, the "Sprachenzentrum" or the Center for Applied Cultural Studies and Studium Generale.

Title and credits of the achievement are adopted.





T**7.238 Course: Seminar Accessibility - Assistive Technologies for Visually Impaired Persons [T-INFO-104742]****Responsible:** Prof. Dr.-Ing. Rainer Stiefelhagen**Organisation:** KIT Department of Informatics**Part of:** [M-INFO-102374 - Seminar Accessibility - Assistive Technologies for Visually Impaired Persons](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each winter term	2

T**7.239 Course: Seminar Application of Artificial Intelligence in Production [T-MACH-112121]****Responsible:** Prof. Dr.-Ing. Jürgen Fleischer**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105968 - Artificial Intelligence in Production](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	3

Events					
ST 2023	2150910	Seminar Application of Artificial Intelligence in Production	2 SWS	Seminar / 	Fleischer

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

Alternative test achievement (graded):

- Presentation of the results (approx. 20 min) followed by a colloquium (approx. 15 min) with weighting 75%
- Written processing of the results with weighting 25%

Prerequisites





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T

7.240 Course: Seminar Creating a Patent Specification [T-ETIT-100754]**Responsible:** Prof. Dr. Wilhelm Stork**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each summer term	1

Events					
ST 2023	2311633	Seminar Creating a Patent Specification	2 SWS	Seminar / 	Stork



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





none

T

7.241 Course: Seminar Data-Mining in Production [T-MACH-108737]**Responsible:** Prof. Dr.-Ing. Gisela Lanza**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105477 - Seminar Data-Mining in Production](#)

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

Events					
WT 22/23	2151643	Seminar Data Mining in Production	2 SWS	Seminar / 	Lanza
ST 2023	2151643	Seminar Data Mining in Production	2 SWS	Seminar / 	Lanza

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

alternative test achievement (graded):

- written elaboration (workload of at least 80 h)
- oral presentation (approx. 30 min)

Prerequisites

none

Annotation

The number of students is limited to twelve. Dates and deadlines for the seminar will be announced at <https://www.wbk.kit.edu/studium-und-lehre.php>.

T



7.242 Course: Seminar Embedded Systems [T-ETIT-100753]





Responsible: Prof. Dr.-Ing. Jürgen Becker
 Prof. Dr.-Ing. Eric Sax
 Prof. Dr. Wilhelm Stork

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-100455 - Seminar Embedded Systems](#)

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

Events					
WT 22/23	2311627	Seminar Embedded Systems	2 SWS	Seminar / 	Becker, Sax, Stork
ST 2023	2311627	Seminar Embedded Systems	2 SWS	Seminar / 	Becker, Sax, Stork

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



Prerequisites





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T

7.243 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-104197 - Seminar for Rail System Technology](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	2

Events					
WT 22/23	2115009	Seminar for Rail System Technology	1 SWS	Seminar / 	Gratzfeld, Tesar, Geimer
ST 2023	2115009	Seminar for Rail System Technology	1 SWS	Seminar / 	Cichon

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

Competence Certificate

Examination: Writing a Seminararbeit, final presentation

Prerequisites

none

T**7.244 Course: Seminar Intelligent Industrial Robots [T-INFO-104526]**

Responsible: Prof. Dr.-Ing. Heinz Wörn
Organisation: KIT Department of Informatics
Part of: [M-INFO-102212 - Seminar Intelligent Industrial Robots](#)

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





Events					
WT 22/23	24785	Intelligent Industrial Robots	2 SWS	Seminar	Hein

T**7.245 Course: Seminar Novel Concepts for Solar Energy Harvesting [T-ETIT-108344]**

Responsible: Prof. Dr. Bryce Sydney Richards
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-103447 - Seminar Novel Concepts for Solar Energy Harvesting](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each summer term	2

Events					
ST 2023	2313761	Seminar Novel Concepts for Solar Energy Harvesting	2 SWS	Seminar / 	Paetzold

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

Competence Certificate

The examination consists of a written journal article and an oral presentation of the student's work, both given in English. The overall impression is rated.



Prerequisites





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T

7.246 Course: Seminar on Quantum Detectors and Sensors [T-ETIT-111235]**Responsible:** Prof. Dr. Sebastian Kempf**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-105607 - Seminar on Quantum Detectors and Sensors](#)

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

Events					
WT 22/23	2312716	Seminar on Quantum Detectors and Sensors	2 SWS	Seminar / 	Kempf, Ilin, Wunsch
ST 2023	2312679	Seminar on Quantum Detectors and Sensors	2 SWS	Seminar / 	Kempf

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

Prerequisites

none

T

7.247 Course: Seminar Project Management for Engineers [T-ETIT-108820]





Responsible: Dr. Christian Day
Prof. Dr. Mathias Noe

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-103248 - Key Competences](#)

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

Events					
ST 2023	2312684	Project Management for Engineers	2 SWS	Seminar / 	Noe

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

Prerequisites

none

T

7.248 Course: Seminar Project Management for Engineers [T-ETIT-100814]

Responsible: Prof. Dr. Mathias Noe
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-103248 - Key Competences](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each summer term	1

Competence Certificate

Type of Examination: Oral exam

Duration of Examination: approx. 30 minutes

Prerequisites

none

Annotation

Not applicable in summer term 2022

Exam and Seminar are held in English.

Detailed information on contents, competence goals, and work load at:



[M-ETIT-100551 – Seminar Project Management for Engineers](#)





T

7.249 Course: Seminar Radar and Communication Systems [T-ETIT-100736]

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100428 - Seminar Radar and Communication Systems](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each term	1

Events					
WT 22/23	2308432	Seminar Radar- and Communication Systems	3 SWS	Seminar / 	Zwick
ST 2023	2308432	Seminar Radar- and Communication Systems	3 SWS	Seminar / 	Zwick, Ulusoy, Mitarbeiter*innen

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

Competence Certificate

The performance evaluation takes place by means of an overall examination of the selected courses, the sum total of which fulfills the minimum requirement of course credits.

The examination takes place in the form of submission of a written report (paper) along with an oral presentation of the individual work. Both are taken into account, while grading the examination performance. The overall impression will be evaluated.

Prerequisites

none


Recommendation





Knowledge of fundamentals of radio frequency engineering are helpful.

T**7.250 Course: Seminar: Energy Informatics [T-INFO-106270]**

Responsible: Prof. Dr. Dorothea Wagner
Organisation: KIT Department of Informatics
Part of: [M-INFO-103153 - Seminar: Energy Informatics](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Irregular	1

Events					
WT 22/23	2400013	Seminar: Energy Informatics	2 SWS	Seminar / 	Wagner, Hagenmeyer, Fichtner, Gritzbach, Wolf, Heidrich, Phipps, Ueckerdt, Bläsius, Göttlicher

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



7.251 Course: Sensors [T-ETIT-101911]

Responsible: Dr. Wolfgang Menesklou
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100378 - Sensors](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	2

Events					
ST 2023	2304231	Sensors	2 SWS	Lecture /	Menesklou

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

T

7.252 Course: SIL Entrepreneurship Project [T-WIWI-110166]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: [M-ETIT-105073 - Student Innovation Lab](#)

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

Events					
WT 22/23	2545082	SIL Entrepreneurship Project	2-4 SWS	Seminar	Terzidis

Competence Certificate

Alternative exam assessment (§4(2), 3 SPO). The final grade is a result from both, the grade of the term paper and its presentation, as well as active participation during the seminar. In addition, smaller, ungraded tasks are provided in the course to monitor progress.

Prerequisites

None

Recommendation

None



7.253 Course: Software Engineering [T-ETIT-108347]

Responsible: Dr. Clemens Reichmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100450 - Software Engineering](#)

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

Events					
WT 22/23	2311611	Software Engineering	2 SWS	Lecture /	Reichmann

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



Prerequisites





none

T 7.254 Course: Solar Energy [T-ETIT-100774]

Responsible: Prof. Dr. Bryce Sydney Richards
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100524 - Solar Energy](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 22/23	2313745	Solar Energy	3 SWS	Lecture / 	Richards, Paetzold
WT 22/23	2313750	Tutorial 2313745 Solar Energy	1 SWS	Practice / 	Richards, Paetzold

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

Prerequisites

Students not allowed to take either of the following modules in addition to this one: „Solarenergie“ (M-ETIT-100476) and „Photovoltaik“ (M-ETIT-100513).

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-ETIT-101939 - Photovoltaics](#) must not have been started.

T

7.255 Course: Spaceborne Radar Remote Sensing [T-ETIT-106056]

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-103042 - Spaceborne Radar Remote Sensing](#)




Type
Written examination


Credits
6

Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events					
ST 2023	2308427	Spaceborne Radar Remote Sensing	1 SWS	/ 	Younis, Prats
ST 2023	2308428	Spaceborne Radar Remote Sensing	2 SWS	Lecture / 	Prats, Moreira
ST 2023	2308429	Tutorial Spaceborne Radar Remote Sensing	1 SWS	Tutorial (/ 	Younis

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

Competence Certificate

Written

Prerequisites

"T-ETIT-101949 - Spaceborne SAR Remote Sensing" is not allowed to be started or to be completed.

Recommendation

Signal processing and radar fundamentals.

Annotation

Actual information can be found at the internet page of the IHE (www.ihe.kit.edu).

T

7.256 Course: Specialisation Module - Self Assignment BeNe [T-ZAK-112346]**Responsible:** Christine Myglas**Organisation:****Part of:** [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

Type	Credits	Grading scale	Version
Examination of another type	6	Grade to a third	1

Competence Certificate

The monitoring occurs in the form of several supplementary courses, which usually comprise a presentation of the (group) project, a written elaboration of the (group) project as well as an individual term paper, if necessary with appendices (examination performances of other kind according to statutes § 5 section 3 No. 3 or § 7 section 7).

The presentation is usually with the accompanying practice partners, as well as the written paper.

Prerequisites

Active participation in all three mandatory components.

Self service assignment of supplementary studies

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation

Knowledge from 'Basic Module ' and 'Elective Module ' is helpful.

T

7.257 Course: Stochastic Information Processing [T-INFO-101366]

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: [M-INFO-100829 - Stochastic Information Processing](#)

Type
Oral examination

Credits
6





Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events


WT 22/23	24113	Stochastic Information Processing	3 SWS	Lecture / 	Hanebeck, Frisch
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

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

T

7.258 Course: Strategy Derivation for Engineers [T-ETIT-111369]**Responsible:** Prof. Dr. Tabea Arndt**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-103248 - Key Competences](#)


Type	Credits	Grading scale	Recurrence	Version
Completed coursework (oral)	3	pass/fail	Each winter term	2





Events					
WT 22/23	2314010	Strategy Derivation for Engineer	2 SWS	Seminar / 	Arndt

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

none

T**7.259 Course: System Integration in Micro- and Nanotechnology [T-MACH-105555]****Responsible:** Dr. Ulrich Gengenbach**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105315 - System Integration in Micro- and Nanotechnology](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each summer term**Version**
1

Events					
ST 2023	2106033	System Integration in Micro- and Nanotechnology I	2 SWS	Lecture / 	Gengenbach


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





oral exam (Duration: 30 min)

Prerequisites

none

T**7.260 Course: System Integration in Micro- and Nanotechnology 2 [T-MACH-110272]****Responsible:** Dr. Ulrich Gengenbach**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-105316 - System Integration in Micro- and Nanotechnology 2](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1

Events					
WT 22/23	2105040	System Integration in Micro- and Nanotechnology 2	2 SWS	Lecture / 	Gengenbach

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

Oral exam, approx. 15 min.

Prerequisites

None

Annotation

Attention: The lecture and exam will be offered for the first time in WS20/21!

T



7.261 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-ETIT-102734 - Materials](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Each summer term	4

Events					
ST 2023	2174576	Systematic Materials Selection	3 SWS	Lecture / 	Dietrich
ST 2023	2174577	Exercises in Systematic Materials Selection	1 SWS	Practice / 	Dietrich, Mitarbeiter

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

Competence Certificate

The assessment is carried out as a written exam of 2 h.

Prerequisites

Application and exam is allowed only in one lecture of this modul ([M-ETIT-102734 - Werkstoffe](#)):

Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-105535 - Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies](#) must not have been started.

Recommendation

Basic knowledge in materials science, mechanics and mechanical design due to the lecture Materials Science I/II.

T

7.262 Course: System-on-Chip Laboratory [T-ETIT-100798]




Responsible: Prof. Dr.-Ing. Jürgen Becker
Prof. Dr. Ivan Peric

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: [M-ETIT-100451 - System-on-Chip Laboratory](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each winter term	1

Events					
WT 22/23	2311612	Laboratory System-on-Chip	4 SWS	Practical course / 	Becker, Peric

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



Prerequisites





none

T

7.263 Course: Systems and Software Engineering [T-ETIT-100675]**Responsible:** Prof. Dr.-Ing. Eric Sax**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100537 - Systems and Software Engineering](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Each winter term	1

Events					
WT 22/23	2311605	Systems and Software Engineering	2 SWS	Lecture / 	Sax
WT 22/23	2311607	Tutorial for 2311605 Systems and Software Engineering	1 SWS	Practice / 	Nägele

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

Competence Certificate

Written exam, approx. 120 minutes. (§4 (2), 1 SPO).

Prerequisites

none

Recommendation

Participation in the lectures Digital System Design and Information Technology is advised

T

7.264 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-105318 - Technical Design in Product Development](#)

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

Events					
ST 2023	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 dictionary is allowed





T

7.265 Course: Technical Optics [T-ETIT-100804]

Responsible: Prof. Dr. Cornelius Neumann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100538 - Technical Optics](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Each winter term	1

Events					
WT 22/23	2313720	Technical Optics	2 SWS	Lecture / 	Neumann
WT 22/23	2313722	Technical Optics (Tutorial to 2313720)	1 SWS	Practice / 	Neumann


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





Prerequisites

none

T

7.266 Course: Thermal Solar Energy [T-MACH-105225]**Responsible:** Prof. Dr. Robert Stieglitz**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-102388 - Thermal Solar Energy](#)**Type**
Oral examination**Credits**
4**Grading scale**
Grade to a third**Recurrence**
Each winter term**Version**
1**Events**

WT 22/23	2169472	Thermal Solar Energy	2 SWS	Lecture / 	Stieglitz
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Competence Certificate**

Oral examination of about 30 minutes

Prerequisites

none

T


7.267 Course: Tutorial Continuum Mechanics of Solids and Fluids [T-MACH-110333]





Responsible: Prof. Dr.-Ing. Thomas Böhlke
Prof. Dr.-Ing. Bettina Frohnäpfel

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-105180 - Continuum Mechanics](#)

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

Events					
WT 22/23	2161253	Tutorial Continuum mechanics of solids and fluids	1 SWS	Practice / 	Dyck, Karl, 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.

T**7.268 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-103205 - Engineering Mechanics](#)

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

Events					
WT 22/23	2161255	Tutorial Mathematical Methods in Continuum Mechanics	2 SWS	Practice / 	Gajek, Lauff, 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

T

7.269 Course: Ubiquitous Computing [T-INFO-101326]

Responsible: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: [M-INFO-100789 - Ubiquitous Computing](#)

Type
Oral examination

Credits
5

Grading scale
Grade to a third

Recurrence
Each winter term

Version
1

Events					
WT 22/23	24146	Ubiquitäre Informationstechnologien	2+1 SWS	Lecture / Practice (Beigl

T**7.270 Course: Ultrasound Imaging [T-ETIT-100822]**

Responsible: Dr. Nicole Rüter
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: [M-ETIT-100560 - Ultrasound Imaging](#)

Type
Oral examination


Credits
3





Grading scale
Grade to a third

Recurrence
Each summer term

Version
1

Events

ST 2023	2305295	Ultrasound Imaging	2 SWS	Lecture / 	Rüter
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

Prerequisites

none


T**7.271 Course: Vehicle Lightweight Design - Strategies, Concepts, Materials [T-MACH-105237]**





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

Lightweight Design

Part of: [M-MACH-102703 - Vehicle Lightweight Design - Strategies, Concepts, Materials](#)

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

Events					
WT 22/23	2113102	Vehicle Lightweight design – Strategies, Concepts, Materials	2 SWS	Lecture / 	Henning

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

Competence Certificate

Written exam; Duration approx. 90 min

Prerequisites

none

Recommendation

none



T




7.272 Course: Virtual Engineering I [T-MACH-102123]

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

Part of: [M-MACH-101283 - Virtual Engineering A](#)
[M-MACH-105293 - Virtual Engineering 1](#)

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

Events					
WT 22/23	2121352	Virtual Engineering I	2 SWS	Lecture / 	Ovtcharova
WT 22/23	2121353	Exercises Virtual Engineering I	2 SWS	Practice / 	Ovtcharova, Mitarbeiter

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

Competence Certificate
 Written examination 90 min.

Prerequisites
 None



T





7.273 Course: Virtual Engineering Lab [T-MACH-106740]

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

Part of: [M-MACH-101283 - Virtual Engineering A](#)
[M-MACH-105475 - Virtual Engineering Lab](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each term	1

Events					
WT 22/23	2123350	Virtual Engineering Lab	3 SWS	Project (P / )	Ovtcharova, Häfner
ST 2023	2123350	Virtual Engineering Lab	3 SWS	Project (P / )	Ovtcharova, Häfner

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

Competence Certificate

Assessment of another type (graded), Group project to create a VR application (project task, implementation and presentation of the project work)

T



7.274 Course: Virtual Solution Methods and Processes [T-MACH-111285]




Responsible: Dipl.-Ing. Thomas Maier
Prof. Dr.-Ing. Jivka Ovtcharova

Organisation: KIT Department of Mechanical Engineering

Part of: [M-MACH-101283 - Virtual Engineering A](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	4	Grade to a third	Each term	1 terms	1

Events					
WT 22/23	2121003	Virtual Solution Methods and Processes	4 SWS	Project (P / )	Ovtcharova, Maier
ST 2023	2121003	Virtual Solution Methods and Processes	4 SWS	Project (P / )	Ovtcharova, Maier

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

Competence Certificate

Graded examination performance of another type weighted according to: 30% project documentation, 30% colloquium and 40% successfully completed project task.

Prerequisites

None



Recommendation





None

T

7.275 Course: Virtual Training Factory 4.X [T-MACH-106741]**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-101283 - Virtual Engineering A](#)

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

Events					
WT 22/23	2123351	Virtual training factory 4.X		/ 	Ovtcharova, Mitarbeiter
ST 2023	2123351	Virtual training factory 4.X	3 SWS	Project (P / 	Ovtcharova

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

Assessment of another type (graded), Group project (project work, final presentation) for the modeling of production plants in VR

Prerequisites

none

T

7.276 Course: Wearable Robotic Technologies [T-INFO-106557]





Responsible: Prof. Dr.-Ing. Tamim Asfour
Prof. Dr.-Ing. Michael Beigl

Organisation: KIT Department of Informatics

Part of: [M-INFO-103294 - Wearable Robotic Technologies](#)

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

Events					
ST 2023	2400062	Wearable Robotic Technologies	2 SWS	Lecture / 	Asfour, Beigl

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 60 minutes.

Prerequisites

Attending the lecture Mechano-Informatics and Robotics is recommended.

Recommendation

Attending the lecture Mechano-Informatics and Robotics is recommended.