Technische Hochschule Rosenheim

Study Plan
Master
Advanced Industrial Engineering AIE (consecutive)

SPO AIE 2020-05

Study and Examination Regulations of 30. May 20 23 for students starting their studies on or after 01.10.2023.

Valid from winter semester 2023/24

Approved by the Faculty Council on June 26, 2023

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Inhalt

1 Preliminary Remark

The legal basis for the curriculum is the study and examination regulations of the Master's Program in Advanced Industrial Engineering. Section 6 reads:

(1) The Faculty of Management and Engineering produces a study plan detailing the course structure for the students' information and to ensure compliance with the curriculum. It is approved by the Faculty Council and is published within the university. New regulations must be published at the latest at the start of the semester in which the regulations come into force for the first time. In particular, the study plan includes regulations and information on:

1. Objectives, content, hours per week per semester, credit points and types of lecture used in individual modules, if this is not regulated conclusively in these rules, and, in particular, a list of current required elective modules, including conditions and restrictions regarding student numbers.

2. More detailed conditions relating to examinations, certificates of attendance and admission requirements.

(2) No assertion is made that all required elective modules and elective modules shall actually be available. Equally, no assertion is made that associated lectures shall be conducted if there are insufficient attendees. The Examination Committee can also set requirements for attendance as well as maximum numbers of attendees for certain lectures.

The links contained in this document lead to the corresponding content on the website of Rosenheim University of Applied Sciences. The content on the website is constantly updated; however, the contents of this document are valid for the semester mentioned on the cover page.

2 Study objectives and structure of the course

(1) The Master's Degree Program in Advanced Industrial Engineering (M. Sc.) is devised as an application focused, consecutive course. It aims to provide students with advanced and specialist knowledge in the technical/business field and related areas with a scientific foundation, especially interdisciplinary knowledge.

(2) The aim of the degree program is to train for a globalized world with a strong intercultural understanding and an international perspective. This orientation is implemented through exclusively English-language courses and thus addressing an international target audience.

(3) In addition to technical and methodological knowledge, the degree program particularly imparts social skills for both socially responsible as well as independent and responsible action. Students are put in a position in which they are able to shape their actions in the context of social processes in a critical and reflective manner, with a sense of responsibility.

(4) The practical relevance is guaranteed beyond working on projects by a scientific Master's thesis.

(5) The degree program prepares students for management and expert tasks in various professions in internationally active commercial enterprises, in the public sector and in self-employed activities. The Master's program also opens up the possibility for students to subsequently pursue a doctoral degree or work in research.

(6) Particular attention is paid to the topics of digitalization, sustainability and internationalization.

The Master's program has a standard period of study of three semesters as full-time studies and a maximum of six semesters as part-time studies. The program includes a practical project (Master Case Study) as well as a Master's thesis to be carried out in the final semester.

Degree: Master of Science (M. Sc.)

The program is divided into the following module groups

- Engineering
- Management Skills
- Sustainability
- Digital Transformation
- Scientific Working
- Elective Courses
- Praxis (Master Case Study and Master Thesis).

3 Study content and course

Figure 1 shows the curriculum. The individual modules are assigned to the module groups based on the color coding. The objective is to earn an average of 30 credit points (European Credit Transfer System ECTS) per semester. During the entire course of study, 90 credit points (ECTS) must be earned.

1. Semester	(30 ECTS)	
Advanced Topics in Industrial Engineering (5 ECTS)	Developing Management and Leadership Skills (5 ECTS)	Digital Twin for Production (5 ECTS)
Quality Control and Six Sigma (5 ECTS)	Strategic Management and Controlling (5 ECTS)	Elective Course (5 ECTS)
2. Semester	(30 ECTS)	
Advanced Production Technologies (5 ECTS)	Sustainable Engineering (5 ECTS)	Digital Transformation in Manufacturing (Project) (5 ECTS)
Scientific Working (5 ECTS)	Circular Economy and Closed-Loop Supply Chains (5 ECTS)	Elective Course (5 ECTS)
3. Semester	(30 ECTS)	
Master Case Study (5 ECTS)	Master Thesis (25 ECTS)	

Engineering	Management Skills	Sustainability	Digital Transformation	Elective	Cross-Curricular

Figure 1: Curriculum

The subject specific elective courses are created individually from the elective modules offered in the curriculum (see section 4).

4 Choices

4.1 Module group Subject Specific Elective Modules

Elective modules offer the opportunity to deepen topics according to personal interests.

4.1.1 Offerings

Modules can be chosen from the following offers:

4.1.1.1 Modules from the FWPM catalogue of the Faculty of Management and Engineering

Every semester, the Faculty of Management and Engineering prepares a catalogue showing which modules can be taken as subject-specific elective modules (FWPM). The subject catalogue as well as the module descriptions of the FWPM can be found on the following page. Successfully passed FWPM are automatically credited to the FWPM module group. The catalogue is valid for students of the Master's Program Advanced Industrial Engineering.

Conditions/ Occupancy:

- The subject must fit into your curriculum .
- The range of modules and the number of participants per module are limited. The modules are allocated via an election procedure.
- The election procedure is carried out via the TH dashboard (menu item "FWPM").
- The subject catalogue, more information on the elections and the module descriptions of the FWPMs can be found below.

Registration for the exam:

- Within the registration period via the Online Service Center.

FWPM catalogue
Winter Semester 2023/2024

Part 1
Offers of the Faculty of Management and Engineering

SG	Modul	SWS	ECTS	Dozent	Oral exam	Written exam	PStA */ Case study	WiSe/ SoSe
WI	Programming for Data Science	4	5	Prof. Noah Klarmann		X		WiSe

Part 2
Student Research Projects

WI	**Student Research Projects**	Up to 5 ECTS		all Prof of Faculty of Management and Engineering				WiSe/ SoSe

Part 3
Offers from other faculties

SG	Modul	SWS	ECTS	Dozent	Mündliche Prüfung	Schriftliche Prüfung	PStA / Case study	WiSe/ SoSe
CCC	Deutsch A1 kompakt	4	5	Mr. Andreas Heusinger		X	X	WiSe
CCC	Deutsch A2 kompakt	4	5	Mrs. Dr. Barbara Lembcke		X	X	WiSe
CCC	Deutsch B1.1	4	5	Mrs. Dr. Nelia Edelmann		X	X	WiSe
CCC	Deutsch B1.2	4	5	Mrs. Dr. Barbara Lembcke		X	X	WiSe
CCC	Deutsch B2 kompakt	4	5	Mrs. Susanne Mayr		X	X	WiSe
all	Upon request modules from other faculties or the Virtual University of Bavaria VHB							

The teaching content of the individual modules can be viewed via the respective faculties!

PStA *: Prüfungsstudienarbeit -> Exam study paper

4.1.1.2 Student Research Project

A student research project can be counted as an FWPM (Elective course).

An information sheet and the registration form can be found on our website.

4.1.2 Please note

- The elective courses (FWPM) shown in the module catalogue are only intended to illustrate the free choice, but not the number of FWPM to be taken. The SWS (semester hours per week) and CP (credit points) shown are also only exemplary. The actual SWS and CP of the different FWPM can be found in the respective module description. When selecting the FWPM, make sure to achieve the required number of credit points!
- The subjects taken first are treated as compulsory subjects. All subjects beyond this are treated as electives and are not included in the grade point average.

4.2 Practice

The module group "Practice" includes the Master's Case Study and the Master's thesis.

Master's case study and Master's thesis are possible in Germany and abroad (see also section „7 **Fehler! Verweisquelle konnte nicht gefunden werden.**“).

4.2.1 Master Case Study (MCS)

The Master Case Study is completed as part of a relevant practical activity.

The "Master Case Study (MCS)" comprises 10 weeks of internship / project work and is documented in the form of a project report. It can be completed in a commercial/industrial enterprise and/or in a research institute.

4.2.1.1 Preconditions

Registration or the start of the MCS is planned for the third semester in the Master's program AIE.

The topic of the Master's Case Study can be issued at the earliest if the student has achieved at least 30 credit points in the Master's program and has fulfilled the requirements of section 3 para. 3 and 4 of the Study and Examination Regulations Master AIE.

4.2.1.2 Design

The Master Case Study can be designed in two forms:

1. It is processed as a preliminary study for the actual master's thesis and prepares the problem area to be dealt with in the thesis. In the thesis, the MCS may be cited as a "reference".
2. It represents an independent problem case, which is not related to the thesis. The MCS can also be carried out in another institution where the thesis is being worked on.

4.2.1.3 Scope of the Master Case Study

The scope of the Master Case Study of 5 CP corresponds to a total workload of approx. 150 working hours. Thus, data collection, justifications and structured problem descriptions are expected. As a rule, a written volume of approx. 25 pages (+/-) has turned out. This is an indication, not a guideline.

4.2.1.4 Announce

Before starting the MCS, the student must submit an application to the examination board for the implementation of the MCS. To do this, use the appropriate application (see forms).

The following registration regulations apply:

- The registration is paperless on the above-mentioned .PDF form. The completed and signed form will be sent as a PDF document by e-mail to andreas.straube@th-rosenheim.de.
- File format: PDF (electronically signed or scanned).
- The sender address must be the TH-Rosenheim e-mail address (...@stud.th-rosenheim.de).
- Students will **not receive a** copy of the application.

4.2.1.5 Language

The MCS can be written in German or English.

4.2.1.6 Content requirements

In the MCS, a complex, networked problem area from industry, business, science or authorities is to be systematically analysed and examined for the need for action or possible solutions. The problem should raise holistic, overarching questions that affect the typical environment of industrial engineering, e.g. questions from technology management, project structures, production environment, applied research fields, etc.

The problems and current situation should be reflected in the state of the art and science.

A structured description of the background of the problem, possible/necessary solutions as well as a recommendation for further processing of the solution field are the content of the elaboration. The analysed problems are to be described in a comprehensible and plausible manner with evidence from data or facts. The probable potentials of a solution to the problem must be shown and, if necessary, compared.

The preparation should correspond to a management report in concise form and clear clarity.

4.2.1.7 Structure, formal requirements

The MCS should correspond to the following structure in terms of content:

- Title page (Master Case Study, topic, name of the student, date)
- Declaration of independence
  Hereby I declare that I have written the present work independently, that I have not used any sources and aids other than those indicated, and that I have marked literal and analogous quotations as such. This work has not been submitted to any other body for a similar purpose. The insurance also covers graphic representations and attached or underlying software.
  Location, Date Signature
- Half-page summary of the work

- Table of contents (max. usually divided up to the third level of structure)
- List of figures, tables and attachments
- List of abbreviations (abbreviations from sources are not listed, e.g. ed. etc.)
- Text pages with consecutively numbered pages, illustrations, tables and references.
    - Systematic presentation of the problem and task
    - Procedure
    - Sketching the (scientific) environment
    - Identification of alternative solutions and implementation proposals
- Bibliography, list of sources

The formal guidelines and requirements for the Master Case Study are analogous to those for theses. Further information can be found on the Master Case Study website.

4.2.1.8 Submission and evaluation of the Master Case Study

The Master Case Study (MCS) concludes with a project report/management report and is submitted to the examination board for evaluation.

The following tax regulations apply:

- The finished work will be sent as a PDF document by e-mail to: andreas.straube@th-rosenheim.de. At the same time as this e-mail, a declaration of independence (form as for theses) must be sent by e-mail.
- File format: PDF.
- The sender address must be the TH-Rosenheim e-mail address (...@stud.th-rosenheim.de).

The evaluation is then paperless using the existing registration form and can be viewed in the OSC.

The grade is "passed" or "failed" and is not included in the overall grade.

4.2.2 Master-Thesis

The master's thesis (final thesis) should show that the student is able to independently work on a problem area from business and/or science according to scientific methods.

4.2.2.1 Preconditions

The topic of the Master's thesis can be issued at the earliest if the student has achieved at least 45 credit points in the Master's program and has fulfilled the requirements of section 3 para. 3 and 4 of the Study and Examination Regulations AIE-Master.

4.2.2.2 Topic and examiner

If the student proves the necessary requirements (see above), he/she can propose or apply for a topic of his/her choice for the Master's Thesis as well as the examiners of this thesis. The Master's Thesis will be reviewed and graded by two examiners. At least one person of these two examiners must be

a full-time professor at the Faculty of Industrial Engineering and Management at Rosenheim University of Applied Sciences.

If a topic is not proposed for an unreasonably long period of time, even though the requirements are met, the issue of the topic of the Master's thesis can also be arranged without a proposal by the examination board. The examination board decides on the appropriateness.

The examiner as well as the start and submission dates of the Master's thesis will be confirmed by the WI examination board.

The determination of a topic is legally binding if it is determined by a decision of the examination board.

The topic of the Master's thesis can be changed in justified individual cases upon request (see "Forms") by first and second examiners.

4.2.2.3 Returning the topic

If a Master's thesis cannot be completed with the registered assignment, the student can apply for a new topic to be worked on (see "Forms").

The return of the old topic must be justified in writing by the student and assessed by the first and second examiners. A decision is made by the chairman of the examination board. If the student is not responsible for the valid reasons for a return, the Master's thesis will not be graded.

If the chairman of the examination board does not agree to the return due to a lack of valid reasons, the master's thesis with the topic must be submitted within the set deadline.

4.2.2.4 Editing a new topic

The new topic must be determined by the supervisor within four weeks of the decision of the examination board, i.e. after the approval of the return.

The new topic of the master's thesis must not be identical to the old topic in terms of content.

4.2.2.5 Registration

The registration modalities for theses are centrally regulated for all degree programs at TH Rosenheim. The link to the corresponding pages can be found under "Forms".

4.2.2.6 Run time

The deadline for processing the master's thesis is 6 months.

The period begins at the time of registration and can be extended by a maximum of 3 months, provided that the student is not responsible for the reasons for this. You can find the relevant information under "Forms".

If the Master's thesis is not properly submitted to the university's examination office within the specified deadline, it will be graded with a grade of 5 (not sufficient).

4.2.2.7 Repetition of a Master´s Thesis

A master's thesis graded "insufficient" can be repeated once **with a new topic**.

4.2.2.8 Workload

The workload for the master´s thesis is 25 CP.

4.2.2.9 Language

The Master's thesis can be written in German or English. A summary in German must be included in any case.

4.2.2.10 Structure, formal guidelines

The master's thesis should correspond to the following content:

- Title page (name and matriculation number of the student, name of first and second examiner, name of the university, date)
- Declaration of independence
  I hereby declare that I have written the present work independently, that I have not used any sources and aids other than those indicated, and that I have marked literal and analogous quotations as such. This work has not been submitted to any other body for a similar purpose. The insurance also covers graphic representations and attached or underlying software.
- Abstract in German and English (maximum one page each)
- Table of contents (max. divided up to the third level of structure)
- List of figures, tables and attachments
- List of abbreviations (abbreviations from sources are not listed, e.g. ed. etc.)
- Text pages with numbered pages, figures, tables and references
- Bibliography, list of sources

The formal guidelines and requirements for the master's thesis are analogous to those for theses. Further information can be found on the website of the Master's thesis.

4.2.2.11 Submission of the Master´s thesis

The submission modalities for theses are centrally regulated for all degree programs at TH Rosenheim. The link to the corresponding pages can be found under "Forms".

5 *Module Descriptions*

The module descriptions briefly show the content and scope of the lectures in the Master's program "Advanced Industrial Engineering". They also show the underlying "workload" as well as any requirements for students.

You will find the module descriptions for the modules offered in the module handbook in the appendix.

Information on the examination modalities can be found in examination announcement.

6 Extended range of courses

The "extended range of courses" is to be understood as courses that are offered outside of official teaching.

These can be, for example, excursions, discussion forums with external experts, management or time training seminars and much more.

There are no fixed courses for the "extended range of courses", but it is expected that the students articulate such needs on the initiative and present them to the head of the degree program. He will then organize the desired event within the scope of the university's possibilities. Participants may be charged a proportionate fee for the costs.

7 Semester abroad

As part of the Master's Program in Advanced Industrial Engineering at Rosenheim University of Applied Sciences , there are various opportunities to extend your studies with a stay abroad for study purposes.

More information can be found on the website of the International Office.

We are happy to support you if you want to focus internationally. Please contact the International Coordinator of the Faculty of Management and Engineering.

8 Student Advisory Service

If students have not achieved at least 30 credit points after two semesters of study, they are obliged to visit the Student Advisory Service at the request of the examination board.

9 Legal Basis

9.1 Study and Examination Regulations

The currently valid versions of the study and examination regulations for the Master's Program Advanced Industrial Engineering at the Rosenheim University of Applied Sciences, further regulations (general examination regulations, laws and regulations, standards, ...) as well as the corresponding contact persons can be found on the website of the Master´s program Advanced Industrial Engineering.

9.2 Examination Announcements

The exact form of the respective examination is laid down and published at the beginning of each semester in the examination announcement. Combinations of exam study paper (PStA) and written

exam (schrP) are possible, stating the duration and weighting in the above-mentioned announcement.

9.3 Note for Master´s students with a university degree of less than 210 ECTS

Below you will find an excerpt from the study and examination regulations (as of May 30, 2023:

Section 3 Admission requirements

(3) If applicants submit proof of a qualification required for admission that is worth less than 210 ECTS credit points but at least 180 ECTS credit points or equivalent, they must acquire the missing credit points from relevant undergraduate courses at Rosenheim Technical University of Applied Sciences. On admission, the Examination Committee shall determine which courses and examinations need to be taken in the individual case. Catch-up examinations must be taken before the Master's thesis is issued. Section 19 of the General Examination Regulations of Rosenheim Technical University of Applied Sciences (APO) applies accordingly to opportunities to resit failed examinations.

The students coordinate the procedure with the examination board in advance.

9.4 Examination Board and Chairman

For a period of three years, the Faculty Council appoints an examination board consisting of three professors from the Faculty of Management and Engineering as well as the chairman elected by the examination board from among its members.

The chairman of the examination board is Prof. Dr.-Ing. Andreas Straube.

10 Annex

- Module handbook – Advanced Industrial Engineering

Technische Hochschule Rosenheim

Module Handbook
Master´s Program
Advanced Industrial Engineering

At Campus Chiemgau. Rosenheim Technical University of Applied Sciences

Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023

Valid from WS 2023

The Dean of Studies of the Advanced Industrial Engineering program (consecutive)
Traunstein, July 28, 2023

According to the valid study and examination regulations, the modules listed in this module handbook are by default only included in the curriculum of Advanced Industrial Engineering. In principle, it is open to students of other degree programs of the Rosenheim Technical University of Applied Sciences to take a module of this degree program upon request to the respective module supervisor and to have it recognized by the respective examination board of the other degree program. However, regular cooperation or recognition does not take place.

SWS is the German abbreviation for "Semesterwochenstunden" which translates to "semester hours per week" and indicates the number of 45-minute periods that a course comprises per week during the lecture period of a semester. For example, 2 SWS means that, during the lecture period of a semester, this course takes place with 2 teaching units (in fact 2 x 45 minutes) per week.

Contents

Advanced Production Technologies

Module number	AIE-I-E03 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Summer Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Module Category: Engineering
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

English level B2

Module Objectives/ Desired Learning Outcomes - Knowledge

Upon completion of the module "Advanced Production Technologies," students will:

1. Understand advanced production technologies and their industrial applications.
2. Know the driver technologies for each industrial revolution and what enabled the breakthrough of an industrial revolution (industry 1.0 to 4.0).
3. Explain the principles and benefits of digital manufacturing, including CAD, CAM, CIM and industry 4.0.
4. Describe the concept of smart factories and the integration of Industrial Internet of Things IIoT, Digital Shadows, Digital Twins and Cyber Physical Systems in production systems.
5. Assess the suitability of additive manufacturing techniques, such as 3D printing, for specific manufacturing scenarios.
6. Recognize the challenges and opportunities in implementing advanced production technologies.

These knowledge-based learning outcomes provide students with a strong foundation in

understanding and applying advanced production technologies in real-world industrial contexts.

Module Objectives/ Desired Learning Outcomes - Skills

Upon completion of the module "Advanced Production Technologies," students will be able to:

1. Apply their understanding of advanced production technologies to analyze and solve real-world industrial problems.
2. Identify technological drivers for industrial revolutions and incorporate this knowledge for integration of new technologies in future production systems.
3. Utilize the principles and functionalities of digital manufacturing, including CAD, CAM, and CIM and industry 4.0, smart factories, integration of Industrial Internet of Things IIoT, Digital Shadows, Digital Twins and Cyber Physical Systems to optimize production processes.
4. Demonstrate critical thinking and problem-solving skills in identifying and addressing challenges and opportunities related to the implementation of advanced production technologies.
5. Communicate their findings and recommendations related to advanced production technologies in a clear and concise manner to both technical and non-technical stakeholders.
6. Stay updated on the latest advancements and emerging trends in the field of advanced production technologies through continuous learning and professional development.

By developing these skills, students will be equipped with the necessary practical abilities to apply advanced production technologies effectively in industrial engineering contexts and contribute to the improvement and innovation of production processes.

Module Objectives/ Desired Learning Outcomes - Competences

Upon completion of the module "Advanced Production Technologies," students will be able to:

1. Apply their knowledge and skills in advanced production technologies to identify and evaluate suitable technological solutions for specific industrial engineering tasks.
2. Demonstrate a holistic understanding of the implications and potential impact of advanced production technologies on industrial processes, productivity, and competitiveness.
3. Exercise critical thinking and problem-solving abilities to analyze, interpret, and draw conclusions from data and information related to advanced production technologies.
4. Collaborate effectively in interdisciplinary teams, fostering teamwork, communication, and leadership skills to achieve common goals related to advanced production technologies.
5. Exhibit ethical and responsible decision-making in the application and implementation of advanced production technologies, considering factors such as sustainability, safety, and ethical implications.

By developing these competences, students will be prepared to effectively navigate the complex landscape of advanced production technologies and contribute to the strategic planning, implementation, and management of these technologies in industrial engineering settings.

Content

The content of the module "Advanced Production Technologies" focuses on exploring advanced and innovative techniques and technologies used in the field of production and manufacturing. It encompasses a range of topics related to optimizing production processes, improving productivity, and enhancing product quality. The module delves into cutting-edge advancements in areas such as automation, robotics, digital manufacturing, additive manufacturing, and smart factory concepts.
The primary objective is to provide students with a comprehensive understanding of these advanced production technologies and their applications in various industrial sectors. Through theoretical knowledge and practical examples, students will gain insights into the underlying principles, functionalities, and benefits of these technologies.

The module covers topics such as:

1. Industry 1.0 to 4.0: Understanding the driver of each industrial revolution and enabler for the breakthrough of new technologies.
2. Digital Manufacturing: Exploring the concept of digital manufacturing, including computer-aided design and manufacturing (CAD/CAM), computer-integrated manufacturing (CIM), and the concept of industry 4.0.
3. Smart Factory and Industrial Internet of Things (IIoT): Examining the concept of smart factories and the integration of the Industrial Internet of Things (IIoT) in production systems, including real-time data analytics, connectivity, and cyber-physical systems.
4. Automation and Robotics: Understanding the role of automation and robotics in production processes, including robotic systems, industrial automation systems, and their integration with manufacturing operations.
5. Additive Manufacturing: Studying additive manufacturing techniques, including 3D printing, rapid prototyping, and their applications in creating complex geometries, customized products, and small-batch production.

Throughout the module, students will also gain practical experience through hands-on exercises, case studies, and possibly site visits to manufacturing facilities or research centers. By the end of the module, students should have a solid understanding of the latest advancements in production technologies and their potential impact on industrial operations.

Recommended literature

- Piller, Frank T. ; Nitsch, Verena ; Lüttgens, Dirk ; Mertens, Alexander ; Pütz, Sebastian ; Dyck, Marc Van: Forecasting Next Generation Manufacturing : Digital Shadows, Human-Machine Collaboration, and Data-driven Business Models. Singapore: Springer Nature, 2022. -ISBN 978-3-031-07734-0. S. 1-158

- Amit, R. K. ; Pawar, Kulwant S. ; Sundarraj, R. P. ; Ratchev, Svetan: Advances in Digital Manufacturing Systems : Technologies, Business Models, and Adoption. Singapore: Springer Nature, 2023. -ISBN 978-9-811-97071-9. S. 1-265
- Leary, Martin: Design for Additive Manufacturing. Amsterdam: Elsevier, 2020. -ISBN 978-0-128-16887-5. S. 1-358

Advanced Topics in Industrial Engineering

Module number	AIE-I-E01 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Module Category: Engineering
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 8 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

English level B2

Module Objectives/ Desired Learning Outcomes - Knowledge

Upon completion of this module, students will acquire the following knowledge:

1. understanding of the operating principles of new technologies used in the field of Industrial Engineering.
2. knowledge of the possible applications of these technologies in the context of Industrial Engineering.
3. knowledge of the success factors for the successful use of the technologies.
4. familiarity with the current technical capabilities and limitations of these technologies in the industrial environment.

Students will develop a solid understanding of the fundamentals and benefits of emerging technologies in industrial engineering. Through exposure to the operating principles, potential applications, success factors, and limitations of these technologies, they will be empowered to make informed decisions regarding their application in an industrial context.

Module Objectives/ Desired Learning Outcomes - Skills

In this module, students should develop the following skills:

1. practical application of the new technologies in the innovation laboratory: students should be able to practically apply the technologies they have learned and understand how they work. By actively working in an innovation lab, they will be able to develop their skills in applying the technologies.
2. implementation of success factors: students should acquire the necessary skills to identify and successfully implement the success factors for the use of the technologies. This includes, for example, ensuring data quality or successfully integrating artificial intelligence into industrial processes.
3. skill to collaborate in groups: Students will develop the skill to successfully implement the new technologies in a group setting. This includes effectively communicating, coordinating, and collaborating with other team members to achieve common goals.

By developing these skills, students will be able to not only understand the technologies they learn in theory, but also apply them in practice. They will be able to identify and implement the success factors for using the technologies and work effectively in groups to implement technology-based solutions in industrial engineering.

Module Objectives/ Desired Learning Outcomes - Competences

In this module, students will develop the following competencies:

1. use of expert knowledge and skills: Students will be able to use their acquired expertise and skills to select appropriate new technologies for specific industrial engineering tasks. They will be empowered to make informed decisions and select appropriate technologies for identifying and solving industrial challenges.
2. Successful implementation of technologies: Students will develop the competency to successfully implement the selected technologies in the Industrial Engineering environment. This includes planning, implementing, and monitoring projects to effectively use the technologies and achieve positive results.

By developing these competencies, students will be able to target their expertise and skills to select and successfully implement the right technologies for industrial tasks. They will be empowered to develop innovative solutions and contribute positively to the advancement of industrial engineering.

Content

The module "Advanced Topics in Industrial Engineering" covers the theoretical background and practical application of new technologies in the field of industrial engineering. This includes in particular topics such as neural networks in conjunction with artificial intelligence, data science with a focus on data quality, augmented reality, virtual reality and collaborative robots. Students will gain knowledge of the operating principles of these technologies, their potential applications in the field of industrial engineering, as well as the success factors and current limitations. Through practical application in the innovation lab, they develop skills to implement the technologies,

especially with regard to success factors such as data quality and artificial intelligence. In addition, students will be enabled to successfully use their expertise and skills to select and implement new technologies in the context of industrial engineering.

Recommended literature

- Russell, Stuart Jonathan ; Norvig, Peter: Artificial Intelligence : A Modern Approach. München: Pearson, 2021. -ISBN 978-1-292-40113-3. S. 1-1168
- Provost, Foster ; Fawcett, Tom: Data Science for Business : What You Need to Know about Data Mining and Data-Analytic Thinking. Sebastopol: "O'Reilly Media, Inc.", 2013. (2021 Audio book)
- Schmalstieg, Dieter ; Hollerer, Tobias: Augmented Reality : Principles and Practice. Boston: Addison-Wesley Professional, 2016.
- Mihelj, Matjaz; Novak, Domen ; Begu, Samo: Virtual Reality Technology and Applications. Berlin, Heidelberg: Springer, 2013. -ISBN 978-9-400-76911-3. S. 1-244
- Schunkert, Andreas ; Ryll, Christoph: Kollaborative Roboterapplikationen : Von der Idee bis zur Integration. M: Carl Hanser Verlag GmbH Co KG, 2022. -ISBN 978-3-446-46540-4. S. 1-228

Circular Economy and Closed-Loop Supply Chains

Module number	AIE-I-S02 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Summer Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Module Category: Sustainability
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

English level B2

Module Objectives/ Desired Learning Outcomes - Knowledge

Students should be able to:

1. Demonstrate a comprehensive understanding of the principles and concepts of a circular economy.
2. Explain the key components and benefits of closed-loop supply chains.
3. Understand the environmental, economic, and social implications of transitioning to a circular economy.
4. Describe the role of design for circularity in product development and its impact on closed-loop supply chains.
5. Identify different strategies and technologies for material recovery, recycling, and upcycling in a circular economy.
6. Analyze the challenges and opportunities associated with implementing closed-loop supply chains and circular economy practices.
7. Recognize the role of policy frameworks and regulations in promoting and supporting the transition to a circular economy.

8. Critically evaluate case studies and examples of successful circular economy initiatives and closed-loop supply chain implementations.

By achieving these knowledge-based learning outcomes, students will have a solid understanding of the theoretical foundations and key concepts related to circular economy and closed-loop supply chains. They will be equipped with the necessary knowledge to analyze, evaluate, and contribute to the development and implementation of sustainable practices in various industries.

Module Objectives/ Desired Learning Outcomes - Skills

Students should be able to:

1. Apply circular economy principles to analyze and propose sustainable solutions for real-world supply chain challenges.
2. Utilize design for circularity principles to develop products and systems that minimize waste and enable closed-loop material flows.
3. Evaluate and optimize closed-loop supply chain processes, including reverse logistics, remanufacturing, and recycling.
4. Assess the environmental and economic impacts of different material recovery and recycling strategies within a circular economy context.
5. Collaborate effectively in multidisciplinary teams to develop innovative circular economy and closed-loop supply chain solutions.
6. Apply critical thinking and problem-solving skills to address the challenges and opportunities associated with implementing circular economy practices.
7. Communicate effectively, both orally and in writing, about circular economy and closed-loop supply chain concepts and solutions to diverse stakeholders.
8. Demonstrate adaptability and flexibility in implementing circular economy practices in different industry contexts.

Module Objectives/ Desired Learning Outcomes - Competences

Students should be able to:

1. Apply a systems thinking approach to understand the interdependencies and complexities of circular economy and closed-loop supply chain systems.
2. Demonstrate a deep understanding of the principles and practices of sustainable development and their application in circular economy and closed-loop supply chain contexts.
3. Integrate knowledge from diverse disciplines, such as engineering, economics, and environmental science, to develop comprehensive and innovative solutions for sustainable resource management.
4. Exhibit critical thinking and analytical skills to evaluate the feasibility and effectiveness of circular economy strategies and closed-loop supply chain initiatives.
5. Foster a collaborative and inclusive mindset to work effectively in interdisciplinary teams, respecting diverse perspectives and leveraging collective expertise.
6. Demonstrate ethical awareness and responsibility in decision-making processes related to circular economy and closed-loop supply chains, considering social equity, environmental justice, and stakeholder engagement.

7. Communicate effectively and persuasively, using appropriate mediums and techniques, to advocate for and promote the adoption of circular economy and closed-loop supply chain practices.
8. Engage in continuous learning and professional development to stay updated on emerging trends, innovations, and best practices in the field of circular economy and closed-loop supply chains.

Content

The content of the module "Circular Economy and Closed-Loop Supply Chains" focuses on understanding and applying the principles of circular economy in the context of supply chain management. The module explores the concept of a circular economy, which aims to minimize resource consumption, reduce waste generation, and create a regenerative and sustainable economic system. It also delves into closed-loop supply chains, which enable the efficient reuse, remanufacturing, and recycling of products and materials.

The module may cover the following topics:

1. Introduction to Circular Economy:
   - Understanding the principles and goals of a circular economy.
   - Exploring the benefits and challenges of transitioning to a circular economy.
   - Analyzing the role of circular economy in achieving sustainability goals.
2. Design for Circular Economy:
   - Integrating circular design principles into product development.
   - Assessing eco-design strategies for product durability, recyclability, and disassembly.
   - Exploring innovative design concepts such as product-service systems and sharing economy models.
3. Closed-Loop Supply Chain Management:
   - Understanding the concept and components of a closed-loop supply chain.
   - Analyzing reverse logistics processes for product returns, remanufacturing, and recycling.
   - Exploring strategies for optimizing closed-loop supply chain operations and reducing waste.
4. Sustainable Materials Management:
   - Evaluating material selection criteria for circularity and sustainability.
   - Studying strategies for material recovery, recycling, and upcycling.
   - Examining the role of renewable materials and bio-based alternatives in a circular economy.
5. Circular Business Models:
   - Analyzing different business models that support circular economy principles.
   - Exploring examples of successful circular businesses and their strategies.
   - Assessing the economic and financial aspects of circular business models.
6. Policy and Regulatory Frameworks:

- Understanding the role of government policies and regulations in promoting circular economy.
- Exploring international and national initiatives and frameworks for circular economy adoption.
- Analyzing the challenges and opportunities associated with policy implementation.

Throughout the module, students may engage in case studies, group projects, and discussions that allow them to apply circular economy principles to real-world scenarios. They will develop a comprehensive understanding of circular economy concepts, closed-loop supply chain management strategies, and the role of various stakeholders in transitioning to a more sustainable and circular economic model.

Recommended literature

- Lacy, Peter ; Long, Jessica ; Spindler, Wesley: The Circular Economy Handbook : Realizing the Circular Advantage. Singapore: Springer Nature, 2019. -ISBN 978-1-349-95968-6. S. 1-350
- Zeng X, Ogunseitan OA, Nakamura S, et al. Reshaping global policies for circular economy. Circular Economy, 2022, 1(1): 100003. https://doi.org/10.1016/j.cec.2022.100003
- Ferguson, Mark E. ; Souza, Gilvan C.: Closed-Loop Supply Chains : New Developments to Improve the Sustainability of Business Practices. Boca Raton, Fla: CRC Press, 2010. -ISBN 978-1-420-09526-5. S. 1-257

Deutsch A1 kompakt

Module number	AIE-I-EM02 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	German and English
Assignment to curriculum	Module Category: Specialist required elective modules
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

None

Module Objectives/ Desired Learning Outcomes - Knowledge

Basic knowledge in German on level A1.

Module Objectives/ Desired Learning Outcomes - Skills

Basic knowledge in German on level A1.

Module Objectives/ Desired Learning Outcomes - Competences

Basic knowledge in German on level A1.

Content

The module covers parts of level A1:

- Understanding and using familiar everyday expressions and very basic phrases aimed at the satisfaction of needs of a concrete type Introduction of oneself and others

- Questions and answers about personal details
- Interaction in a simple way provided the other person talks slow-ly and clearly and is prepared to help

Recommended literature

Will be announced by lecturer.

Deutsch A2 kompakt

Module number	AIE-I-EM03 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	German and English
Assignment to curriculum	Module Category: Specialist required elective modules
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

Level A1 according to CEFR

Module Objectives/ Desired Learning Outcomes - Knowledge

Basic knowledge in German on level A2.

Module Objectives/ Desired Learning Outcomes - Skills

Basic knowledge in German on level A2.

Module Objectives/ Desired Learning Outcomes - Competences

Basic knowledge in German on level A2.

Content

The module covers parts of level A2:

- Understanding sentences and frequently used expressions relat-ed to areas of most immediate relevance e.g. very basic personal and family information, shopping, local geography, employment

- Communicating in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine mat-ters
- Describing in simple terms aspects of personal background, im-mediate environment and matters in areas of immediate need

Recommended literature

Will be announced by lecturer.

Deutsch B1.1

Module number	AIE-I-EM04 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	German and English
Assignment to curriculum	Module Category: Specialist required elective modules
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

Level A2 according to CEFR

Module Objectives/ Desired Learning Outcomes - Knowledge

Advanced basic knowledge B1.1.

Module Objectives/ Desired Learning Outcomes - Skills

Advanced basic knowledge B1.1.

Module Objectives/ Desired Learning Outcomes - Competences

Advanced basic knowledge B1.1.

Content

The module covers parts of level B1:

- Understanding the main points of clear standard input on famil-iar matters regularly encountered in university, work, leisure, etc.
- Dealing with most situations in daily life

- Producing simple connected text on topics which are familiar or of personal interest
- Describing experiences and events, dreams, hopes & ambitions and briefly give reasons and explanations for opinions and plans

Recommended literature

Will be announced by lecturer.

Deutsch B1.2

Module number	AIE-I-EM05 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	German and English
Assignment to curriculum	Module Category: Specialist required elective modules
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

Level B1.1 according to CEFR

Module Objectives/ Desired Learning Outcomes - Knowledge

Advanced basic knowledge B1.2

Module Objectives/ Desired Learning Outcomes - Skills

Advanced basic knowledge B1.2

Module Objectives/ Desired Learning Outcomes - Competences

Advanced basic knowledge B1.2

Content

The module covers parts of level B1:

- Understanding the main points of clear standard input on familiar matters regularly encountered in university, work, leisure, etc.
- Dealing with most situations in daily life

- Producing simple connected text on topics which are familiar or of personal interest
- Describing experiences and events, dreams, hopes & ambitions and briefly give reasons and explanations for opinions and plans

Recommended literature

Will be announced by lecturer.

Deutsch B2 kompakt

Module number	AIE-I-EM06 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	German
Assignment to curriculum	Module Category: Specialist required elective modules
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

Niveau B1.2 gemäß GER

Module Objectives/ Desired Learning Outcomes - Knowledge

Independent language use at level B2 according to CEFR

Module Objectives/ Desired Learning Outcomes - Skills

Independent language use at level B2 according to CEFR

Module Objectives/ Desired Learning Outcomes - Competences

Independent language use at level B2 according to CEFR

Content

The module covers parts of level A1:

- Understanding the main ideas of complex text on both concrete and abstract topics, including technical discussions in one's field of specialization

- Interacting with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party
- Producing clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options

Recommended literature

Will be announced by lecturer.

Developing Management and Leadership Skills

Module number	AIE-I-M01 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr. Sonja Unterlechner
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Module Category: Management Skills
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

Work experience, ideally in larger corporations. English level B2.

Module Objectives/ Desired Learning Outcomes - Knowledge

During the first half of the course the students are taught basic leadership and management principles. They learn why developing self-awareness and the ability to create trust are crucial for successful leaders. The students study the four key phases of team development. The second half of the course focuses on communication, methods of gaining power and how to delegate in an effective way. The students also study fundamental differences in leadership styles across the globe. At the end of the course the students learn about stress as well as stress coping and stress management strategies.

Module Objectives/ Desired Learning Outcomes - Skills

The students can differentiate between leadership and management skills. They have the ability to distinguish between formal power and real power. They have to experience the upsides of empowerment and know how to apply it to their future employees. They have reflected on their own behavior and their traits via exercises on developing self-awareness. Additionally, the students have obtained the skill to speak and write about management and leadership topics in a foreign language (i.e. English).

Module Objectives/ Desired Learning Outcomes - Competences

After having completed the course and its combination of theoretical sessions as well as intense practice sessions the students have developed first leadership and management skills. They know how to handle various challenging situations such as low team performance, mistrust in an organization or high absentee rates. The course enables future leaders to have a clear view on required skills as well as their own areas for development and ambitions.

Content

What are leadership and management skills? What does it take to be a successful manager and leader?

- Developing self-awareness
- Building trust
- How to create effective teams
- Communicating effectively and supportively
- Gaining power and influence
- Empowering and delegation
- Managing personal stress
- Motivating and leading internationally
- Wrapping up: Your plans and ambitions

Additionally, recent topics coming up in the press will be covered.

Recommended literature

Key literature:

- Whetten/Cameron (2015): Developing Management Skills, Pearson
- Caproni (2012): Management Skills for Everyday Life, Pearson

Additional literature:

- Deresky (2016): International Management
- Dessler (2017): Human Resource Management
- Dessler (2017): A framework for Human Resource Management
- Gomez-Meija (2016): Managing Human Resources
- Littlefield/Wise (2021): How to make virtual engagement easy
- Mondy (2015): Human Resource Management
- Noe (2021): Human Resource Management - Gaining a competitive advantage
- Robbins/Hunsaker (2014): Training on Interpersonal Skills: TIPS for Managing People at Work

Digital Transformation in Manufacturing (Project)

Module number	AIE-I-D02 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Summer Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Module Category: Digital Transformation
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 20 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

English level B2

Module Objectives/ Desired Learning Outcomes - Knowledge

At the beginning of the semester, the students define a process model suitable for their project and also select the methods to be used themselves. This can be Scrum or Kanban, for example, and may also include elements of other models.

Module Objectives/ Desired Learning Outcomes - Skills

As part of their personal development, they train practice-relevant soft skills such as teamwork, giving and receiving feedback, and giving presentations and sales pitches. They will also learn how to deal with an external client in workshops and meetings.

Module Objectives/ Desired Learning Outcomes - Competences

Students are able to select concepts from various foundation courses as well as their bachelor's degree to achieve project goals and implement them in practice. Students acquire the competence to work in small, self-directed teams and to self-reflect within the team. They understand the control and coordination mechanisms in small teams

(daily standup and shared value system). You will be able to use procedures to improve the approach independently (retrospectives, types of waste). You will learn to work in short regular sprints or iterations. Starting with a planning session and always ending with a demonstration of the project results and self-reflection in a retrospective.

Content

In groups of three to five members, participants carry out challenging projects on their own responsibility, from requirements analysis to commissioning. The project topics can be provided by companies from the region. Internal projects are also possible. The content focus of the projects is in the area of Industrial Engineering with a focus on Digital Transformation and / or Sustainability.
The documentation of the project in written form as well as presentation of interim and final results are an important part of the project. In addition, soft skills of the students are trained in the project. The course is aligned with the modules Advanced Topics in Industrial Engineering, Quality Control and Six Sigma, Digital Twin in Production, Advanced Production Technologies, Sustainable Engineering, Circular Economy and Closed Loop Supply Chains.
The projects are carried out in iterations (sprints). The sprint length and the technical/methodological content are determined depending on the project partner and the topic of the project environment. The student team makes the determination, in coordination with the coach.

Recommended literature

- Rubio, Mauricio: Agile Scrum Course : Scrum Fundamentals : Scrum Certification. Birmingham: Packt Publishing, 2019. -ISBN 978-1-838-64498-7. S.
- Wada, Kazuo: The Evolution of the Toyota Production System. Springer Singapore, 2020. -ISBN 978-9-811-54927-4. S. 1-166
- Womack, James P. ; Jones, Daniel T. ; Roos, Daniel: The Machine That Changed the World. New York: Simon and Schuster, 2008. -ISBN 978-1-847-37596-4. S. 1-352
- T. Ohno: The Toyota Production System, Taylor and Francis, 1988

Digital Twin for Production

Module number	AIE-I-D01 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Oliver Kramer
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Module Category: Digital Transformation
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 50 Excercise: 25 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

No particular previous knowledge from other modules is required to participate in the course - English language skills on the level B2 are sufficient. Participants should bring their own laptop to the course, e.g., for exercises in MS Dynamics (ERP-system, web-based) or Discrete Event Simulation using 'Plant Simulation' from Technomatix (part of the SIEMENS PLM Software Platform).

Module Objectives/ Desired Learning Outcomes - Knowledge

The course consists of 3 major parts.
In the first part of the course, students will learn the basics of a 3D-Master to manage all product data within the development process for the complete value chain. This part is taken over by a lecturer who is responsible for this subject at BMW.
In the second part a lecturer from BSH will teach the elements of their Cost Engineering & Value Stream Engineering Process for the integration of all suppliers in the development, supply and production process.
In the third part Prof. Dr.-Ing. Oliver Kramer will teach the basis of the production process organisation, what options are available for monitoring and control, and what requirements the Digital Twin must meet. Furthermore, he will mention the functionality of tools such as ERP-, MES- and shopfloor-orientated systems. Within

three exercises MS Dynamics (ERP system), the Discrete Event Simulation 'Plant Simulation' and 'proto_lab' will be studied.

Module Objectives/ Desired Learning Outcomes - Skills

In the first part of the course, participants learn and understand the requirements and challenges to build up 3D-based Master to consistently manage all product data for the value chain. In the second and third part the students will learn the functions of the supply and production process and reflect the requirements for a Digital Twin as well as they will work with selected tools (MS Dynamics, Plant Simulation and proto_lab Application). They will achieve an integrated view on the value adding processes and the requirements for a Digital Twin.

Module Objectives/ Desired Learning Outcomes - Competences

An integrated view on the development, supply and production process for decision making within tactical and strategic questions/issues is inherently effective and efficiency-enhancing, and therefore often lead to significant competitive advantages for companies.
To this end, Industrial Engineers work at the interface between product development and value adding processes such as supply and production, where they need both process knowledge and subject-specific knowledge to grasp the problem holistically and extract the right answers from an integrated systems thinking approach.
In this context, the course provides the knowledge and skills necessary to solve real-world development and supply chain problems that course participants will face in their future professional roles as industrial engineers, managers, or engineers/developers. In addition to knowledge of the processes, requirements, challenges, and basic techniques for analysing the overall system, students will gain a foundation for examining the tools and systems to be used and making a preliminary selection for use in real operations.

Content

The course is structured in the following three parts:

1. **3D-Master**: Learning the basics of building up a 3D-Master to manage all product data within the development process for the complete value chain.
2. **Cost Engineering & Value Stream Engineering**: Introduction to the elements of Cost Engineering & Value Stream Engineering Processes for the integration of suppliers in the development, supply and production process of a holistic Supply Chain.
3. **Production Process Organisation**: In the final phase of the course, the participants will be introduced to the basis of the production process organisation and the functionality of tools such as ERP-, MES- and shopfloor-orientated systems. Within three exercises MS Dynamics (ERP system), the Discrete Event Simulation 'Plant Simulation' and 'proto_lab' will be studied.

Recommended literature

- Haslauer, R. / Kitsios, V. 3D-Master: Zeichnungslose Produktbeschreibung mit CATIA V5. Auflage 2014, Springer Vieweg, 2014, ISBN: 978-3-658-05844-7
- Schuh, G. / Stich,V. Produktionsplanung und -steuerung 1: Grundlagen der PPS. 4. Auflage, Springer Vieweg, 2012, ISBN: 978-3-642-25422-2
- Schuh, G. / Stich,V. Produktionsplanung und -steuerung 2: Evolution der PPS. 4. Auflage, Springer Vieweg, 2012, ISBN: 978-3-642-25426-0
- Wiendahl, H.-P. / Wiendahl, H.-H. Betriebsorganisation für Ingenieure. 9th ed., Carl Hanser, 2019, ISBN: 978-3-446-44661-8
- Wiendahl, H.-P. / Wiendahl, H.-H. Betriebsorganisation für Ingenieure. (English Edition) 8th ed., Carl Hanser, 2014, ISBN: 978-3-446-44053-1
- Rother, M. Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA. (English Edition) kindle ed., LMI Forum, 2022
- Gronau, N. ERP-Systeme: Architektur, Management und Funktionen des Enterprise Resource Planning. 4. Auflage, De Gruyter Oldenbourg, 2021, ISBN: 978-3-110-66283-2
- Kletti, J. Die perfekte Produktion: Manufacturing Excellence in der Smart Factory. [Basis für Einsatz von MES-Systemen] 3. Auflage, Springer Vieweg, 2023, UNSPSC-Code : 55111500
- Sinsel, A. Das Internet der Dinge in der Produktion: Smart Manufacturing für Anwender und Lösungsanbieter. 1. Auflage, Springer Vieweg, 2020, ISBN: 978-3-662-59760-6

Master Case Study

Module number	AIE-I-MCS Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter and Summer Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Master Case Study
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 0 Excercise: 0 Practical training: 0 Total: SWS
Work load	Presence: h Self-study: h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

- The knowledge and skills of an industrial engineer at master's level
- project management

Module Objectives/ Desired Learning Outcomes - Knowledge

- Students deepen and broaden their professional, structural and strategic knowledge in industrial-economic or administrative fields depending on the task at hand.
- They deepen the methods of scientific work on practical examples in industry or public authorities.

Module Objectives/ Desired Learning Outcomes - Skills

- Students apply their knowledge of industrial engineering to a complex problem and analyze it in a systematic manner, applying to the task the methods and tools learned during their studies.
- They mirror the problem to the scientific knowledge as well as to the practical possibilities of the state of the art.
- They present the problems in a structured form and in consideration of the scientific obligation to provide evidence.

- They show solution structures and back them up with the necessary evidence and plausibility.

Module Objectives/ Desired Learning Outcomes - Competences

- Students are able to independently develop, describe, present and critically discuss complex technical-business issues and problems methodically and in a scientific approach.
- They reflect the problem at the state of the art and science and show implementation-oriented spectra of a problem solution.
- They reflect and evaluate the possibilities and limitations in the context of the project work.
- They present both the problem and the approaches to solutions in a management report, taking into account scientific work and presentation.

Content

- Analyze a complex, interconnected problem from industry, business or government.
- Structured presentation and evaluation of the problems in compliance with the rules of scientific procedure.
- Reflecting the problem on the state of the art and science.
- Development of solution approaches and reflection of the consequences and potentials.
- Structured presentation of the problem area as well as systematic solutions and an assessment of potential and consequences in the form of a management report.

Recommended literature

depending on topic

Master-Thesis

Module number	AIE-I-MTH Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter and Summer Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	German and English
Assignment to curriculum	Master's Thesis
ECTS	25
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 0 Excercise: 0 Practical training: 0 Total: SWS
Work load	Presence: h Self-study: h Total: 750 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

- Complete master's level industrial engineering knowledge and skills.

Module Objectives/ Desired Learning Outcomes - Knowledge

- Depending on the task at hand, students may work their way into individual technical, economic and integrative topics in addition to the management task.

Module Objectives/ Desired Learning Outcomes - Skills

- Students repeatedly apply their methodological and subject-specific knowledge as well as the principles of scientific work. Thus, they deepen the skills in scientific precision and strategically creative solution finding.
- They practice writing a scientific treatise with (mostly) clearly practice-oriented approaches and prove the feasibility and plausibility of the solutions.

Module Objectives/ Desired Learning Outcomes - Competences

The student demonstrates the following qualifications within the scope of the given topic:

- Independent, problem-oriented and structured analysis of comprehensive issues from the technical-economic environment.
- Reflecting on the entire problem in the context of the multi-layered mutual influence of diverse factors and situations.
- Critical reflection of the problem against the necessary and topic-related scientific state of the art as well as the corresponding documentation.
- Developing solution approaches and implementation recommendations of the given problem definition as well as the corresponding proofs or plausibility.
- Recording and presenting the problem and the results within the framework of a scientific paper and within a given deadline.

Content

Practically and/or theoretically oriented, scientific work from the field of engineering and/or economics.

Recommended literature

Depending on topic

Programming for Data Science

Module number	AIE-I-EM01 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Noah Klarmann
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Module Category: Specialist required elective modules
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 30 Excercise: 30 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

No particular previous knowledge from other modules is required to participate in the course - basic English language skills as well as elementary math skills are sufficient. Participants must bring their own laptop to the course.

Module Objectives/ Desired Learning Outcomes - Knowledge

The course starts with a language-agnostic introduction to basic terms and concepts of programming such as control flows (e.g., if conditions, for loops), data types (e.g., integers, strings, floats), functions (modularized code segments) and the various programming paradigms (e.g., procedural, object-oriented). Moreover, the concept of data-oriented programming is introduced. Students are going to understand under which conditions data is valuable and how it can support decision making in a variety of different applications.

Module Objectives/ Desired Learning Outcomes - Skills

In the first part of the course, participants learn to write programs in Python by solving assignments in supervised exercises. The tutorials address typical problems that the participants will face in their future professional life. In the second part of the course, attendees learn how to develop programs that can handle large data sets. For this

purpose, the commonly used data science libraries are introduced. This includes standard preprocessing steps such as cleaning, transforming, merging, or reshaping the data. Furthermore, students learn to extract valuable insights from large data sets by calculating arbitrary metrics (e.g., statistical properties) and/or visualizing the data.

Module Objectives/ Desired Learning Outcomes - Competences

Data-driven decision making for strategic and operational purposes is inherently objective and efficient and hence frequently lead to significant competitive advantages for companies. To this end, data scientists work at the interface between management and the data-producing entities, where they require programming skills as well as domain knowledge to holistically grasp the problem and to extract the right answers from the data. In this context, the course provides the knowledge and skills necessary to address real-world problems that course participants will face in their future professional roles as managers or engineers/developers. In addition to programming skills and basic data analysis techniques, students will gain a foundation to explore more advanced concepts - such as machine learning - that are subject of subsequent courses.

Content

The course is structured in the following three parts:

1. Programming: Learning to write arbitrary programs in Python (control flows, data types/structures, functions, input and output operations, modules, classes, standard libraries).
2. Data science libraries: Introduction to the standard data science libraries (pandas, matplotlib, NumPy, SciPy).
3. Practical use cases: In the final phase of the course, the participants apply the introduced techniques to real-world data sets.

Recommended literature

- Matthes, E. Python - Crash Course. 2nd ed., no starch press, 2019, ISBN: 978-1-59327-928-8.
- McKinney, W. Python for Data Analysis. 2nd ed., O Reilly, 2017, ISBN: 978-1-491-95766-0.
- van Rossum, G. Python Tutorial. 3.7.0, Python Software Foundation, 2018.

Quality Control and Six Sigma

Module number	AIE-I-E02 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Module Category: Engineering
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 8 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

English level B2

Module Objectives/ Desired Learning Outcomes - Knowledge

Students should achieve the following concrete knowledge:

1. fundamentals of quality assurance: students should develop a solid understanding of the fundamentals of quality assurance. This includes concepts such as quality management, quality control, quality standards and methods, and the importance of quality in various industries.
2. Six Sigma Methodology: students should become familiar with the Six Sigma methodology. They should understand the different phases of the DMAIC (Define, Measure, Analyze, Improve, Control) cycle and how they are used to improve process quality.
3. statistical quality control techniques: Students should gain knowledge of various statistical methods and tools for quality control. These include, for example, SPC (Statistical Process Control) and process capability indices.
4. troubleshooting and problem identification: students should learn how to identify quality control problems and develop effective troubleshooting measures. This

includes the cause and effect diagram (Ishikawa diagram), FMEA (Failure Mode and Effects Analysis), and other root cause analysis methods.
5. quality standards and certifications: Students should develop an understanding of various quality standards and certifications that are recognized in the industry. These include, for example, ISO 9001, ISO 14001, and other industry-specific standards.
6. data analysis and interpretation: students should develop skills in working with qualitative and quantitative data. They should be able to collect, analyze, interpret, and draw conclusions from data for quality improvement.

This concrete knowledge should provide students with a solid foundation in the areas of quality assurance and Six Sigma and prepare them to identify and analyze quality problems and develop effective solutions.

Module Objectives/ Desired Learning Outcomes - Skills

Students will develop the following targeted skills:

1. application of quality control techniques: Students should be able to apply various quality control techniques to monitor the quality of processes and products. This includes, for example, creating and interpreting control charts, performing statistical analysis, and monitoring process capability indices.
2. problem solving and troubleshooting: students should develop the ability to identify and analyze quality assurance problems and develop effective troubleshooting solutions. They should be able to take a systematic approach to determine the root causes of quality problems and implement appropriate troubleshooting actions.
3. data analysis and interpretation: students should develop skills in handling data. They should be able to collect, analyze, interpret, and derive informed decisions from data. This includes the ability to apply statistical methods and tools to analyze data and present results.
4. teamwork and communication: students should develop the ability to work effectively in teams and communicate their ideas and results clearly. They should be able to work together in multidisciplinary teams to solve quality problems and implement improvement projects.
5. process improvement: students should develop the ability to analyze and improve processes. They should be able to use appropriate process improvement tools and methods to improve quality, reduce costs, and achieve efficiency gains.
6. problem solving skills: students should develop their problem solving skills by using analytical thinking, critical thinking and creativity to solve complex quality problems. They should be able to evaluate different approaches to solving problems and make informed decisions.

These targeted skills should enable students to work effectively in the areas of quality assurance and Six Sigma, to identify and solve problems, and to successfully implement improvement projects.

Module Objectives/ Desired Learning Outcomes - Competences

Students will develop the following targeted competencies:

1. analytical competence: students should be able to analyze and understand complex problems in quality assurance. They should be able to interpret data, identify relationships, and draw sound conclusions.
2. problem-solving skills: students should develop the ability to identify and analyze quality problems and develop appropriate approaches to solve them. They should be able to take a systematic approach, evaluate various solution options, and make sound troubleshooting decisions.
3. teamwork and collaboration: students should develop the ability to work effectively in multidisciplinary teams. They should be able to contribute their expertise and skills in quality assurance, coordinate with other team members, and work collaboratively to find solutions.
4. communication skills: students should develop the ability to communicate their ideas, results and solutions clearly and understandably. They should be able to present and explain their findings both orally and in writing to persuade other team members and stakeholders.
5. project management skills: students should learn and be able to apply the fundamentals of project management. They should be able to plan, organize, and monitor quality improvement projects to achieve set goals on time and within budget.
6. continuous learning: students should develop the ability and desire to continuously expand their knowledge and skills in quality assurance. They should be open to new developments and trends in the field and be willing to engage in continuous learning.

These desired competencies should enable students not only to acquire theoretical knowledge and practical skills in quality assurance, but also to develop the skills to apply this knowledge successfully in professional contexts.

Content

In the module "Quality Control and Six Sigma" the following contents are covered:

1. quality assurance fundamentals: introduction to quality assurance fundamentals and concepts, quality management systems and quality standards.
2. Statistical Process Control (SPC): Introduction to statistical process control for monitoring and controlling processes. This includes fundamentals of statistical analysis, control charts, process capability indices and root cause analysis.
3. Six Sigma Methodology: Introduction to Six Sigma methodology to systematically improve processes and reduce variation. This includes the DMAIC (Define, Measure, Analyze, Improve, Control) phases, tools such as cause and effect diagrams, Pareto analyses, FMEA (Failure Mode and Effects Analysis) and statistical analysis methods.
4. Quality Management Tools: Presentation of various quality management tools such as 5-Why analysis, Ishikawa diagram (fishbone diagram), 5S method, Poka-Yoke (failure prevention), and quality function diagram (QFD).
5. application areas of Six Sigma: application of Six Sigma in various industries such as manufacturing, services, and healthcare. Case studies and real-world examples will be discussed to illustrate the practical application of Six Sigma.

The content of the Quality Control and Six Sigma module provides students with a comprehensive understanding of quality management, statistical process control, and the application of Six Sigma methodology to quality improvement. They will learn various tools and techniques that they can use in practice to monitor quality, improve processes, and analyze causes of defects. Case studies and real-world examples help students understand the concepts in real-world application scenarios.

Recommended literature

- Snee, Ronald D. ; Hoerl, Roger Wesley: Leading Six Sigma : A Step-by-step Guide Based on Experience with GE and Other Six Sigma Companies. Harlow: FT Press, 2003. -ISBN 978-0-130-08457-6. S. 1-279
- Krishnamoorthi, K.S. ; Pennathur, Arunkumar ; Krishnamoorthi, V. Ram: A First Course in Quality Engineering : Integrating Statistical and Management Methods of Quality, Third Edition. Boca Raton, Fla: CRC Press, 2018. -ISBN 978-1-498-76421-6. S. 1-626
- George, Michael L. ; Maxey, John ; Rowlands, David T. ; Upton, Malcolm: The Lean Six Sigma Pocket Toolbook: A Quick Reference Guide to Nearly 100 Tools for Improving Quality and Speed. Madison: McGraw Hill Professional, 2004. -ISBN 978-0-071-50573-4. S. 1-282

Scientific Working

Module number	AIE-I-SCW01 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Summer Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Scientific Working
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: SWS
Work load	Presence: h Self-study: h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

English level B2

Module Objectives/ Desired Learning Outcomes - Knowledge

"Scientific Writing" in English is a crucial qualification course for students of all disciplines and all skill levels (Bachelor's, Master's, PhD). Specifically for students of natural sciences who are often required to draft texts in English (ranging from letters & e-mails about papers, to abstracts, to posters, to scientific publication and third party applications), this course shall not only help them encounter the "fear of blank page", but also help them overcome the language barrier. The online seminar "Scientific Writing" aims at targeting students of natural sciences and health sciences who wish to improve their academic writing skills in English. The course navigates from dealing with basic linguistic features to complex expertise of academic writing. Initially the course deals with the first steps of scientific writing, the phase of preparation of the article.

Module Objectives/ Desired Learning Outcomes - Skills

The course explains how to search and manage the scientific literature as well as how to plan the writing process. In a second phase, the course guides through the writing process itself. After dealing with important aspects of English language and expression

in scientific writing, the course offers learning units that help in acquiring expertise in drafting various parts of a scientific publication. Additionally, these learning units offer a step-by-step opportunity to compose one's own scientific publication. In a third phase, the course explains how to publish and present a scientific publication.

Module Objectives/ Desired Learning Outcomes - Competences

In this part of the course students can acquire knowledge not only regarding the procedure of submitting an article to a journal, but also concerning the oral and poster presentation of the scientific publication. The objective of the seminar is to provide a brief theoretical introduction on each topic of the course. Exercises with clearly defined tasks give students the opportunity to test what they have learned and applied directly during the flow of the seminar. Immediate feedback from the tutor can help the students with their queries if they are stuck. The learning objectives are specified at the end of each class. The lectures shall be held independent of other events and shall be open to audiences of all types.

Content

PREPARATION OF THE ARTICLE

1. Introduction
2. Recommended literaturee search
3. Recommended literaturee management
4. Planning of the writing process

THE WRITING PROCESS

1. Language and Expression
2. Methods
3. Introduction and Aims
4. Results
5. Discussion and Conclusion
6. Title and Abstract
7. Visuals
8. Bibliography and Citation

PUBLISHING AND PRESENTING

1. Submission to the journal
2. Oral presentation
3. Poster presentation
4. Peer-reviewing

Recommended literature

Specific literature for each chapter, current papers, will be announced during lectures

Strategic Management and Controlling

Module number	AIE-I-M02 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Winter Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Peter Kraus
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Module Category: Management Skills
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

English level B2

Module Objectives/ Desired Learning Outcomes - Knowledge

The course gives an overview of the principles and foundations, that strategic management and controlling are based on. These principles work in all areas and industries of any society, irrespective of changing trends, of national or of cultural differences.

Module Objectives/ Desired Learning Outcomes - Skills

The students will adopt knowledge of the basic management tools as SWOT analysis, pestel analysis, portfolio analysis (BCG matrix), balanced scorecard, Porter's five forces, Porter's value chain, Ansoff matrix, pareto analysis, turnaround management, lean management and apply them in cases to specific scenarios.

Module Objectives/ Desired Learning Outcomes - Competences

The students will be able to set up strategic actions for specific company situations and to evaluate the financial performance of firms. Reading/ understanding/ drawing the

right conclusions out of balance sheets/profit&loss statements/cashflow statements are part of the competencies adopted as well as finding the right value of a business.

Content

1. Strategic Management
   (a) What is Management
   (b) What is right/good Management
   (c) International Management
   (d) Ethics in Management
   (e) Stakeholders of a company
   (f) Vision/Mission
   (g) Management Tools
   (h) Planning
   (i) Organisation
2. Controlling
   (a) Strategic vs operational Controlling
   (b) Assessing the financial health of the firm
   (c) Evaluating financial performance
   (d) Managing Growth
   (e) The value of money
   (f) Valuing a business

Recommended literature

- Helmold Marc, Successful Management Strategies and tools, Springer, 2021
- Robert C. Higgins, Analysis for Financial Management, Irwin McGraw-Hill, 2018
- Porter M.E., Competitive Advantage, Campus, 1996
- Porter M.E., Competitive Strategies, Campus, 1999
- Fredmund Malik, Management - The essence of the craft, Campus, 2010

Sustainable Engineering

Module number	AIE-I-S01 Study and Examination Regulations AIE 2023-05 (30.05.2023), valid for students starting their studies from 01.10.2023 (see website)
Module start	Summer Semester
Module duration	one semester
Responsible	Prof. Dr.-Ing. Andreas Straube
Lecturer(s)	refer to valid semester timetable (see website)
Language	English
Assignment to curriculum	Module Category: Sustainability
ECTS	5
Group size per teaching method. Semester hours per week (SWS)	Seminar-based lectures: 20 Excercise: 20 Practical training: 0 Total: 4 SWS
Work load	Presence: 60 h Self-study: 90 h Total: 150 h
Prerequisites for the award of ECTS	see Study and Examination Regulations AIE 2023-05 (30.05.2023), study plan and examination announcement (see website: Study and Examination Regulations, study plan, examination announcement)

Recommended prerequisites

English level B2

Module Objectives/ Desired Learning Outcomes - Knowledge

Students should be able to:

1. Demonstrate a comprehensive understanding of the principles and concepts of sustainability in the context of engineering.
2. Understand the environmental, social, and economic dimensions of sustainable development and their relevance to engineering practices.
3. Explain the global challenges and environmental issues that drive the need for sustainable engineering solutions.
4. Identify and assess the environmental impact of engineering activities and processes.
5. Recognize the role of renewable energy sources and sustainable materials in engineering design and operations.
6. Understand the principles and practices of energy efficiency and resource conservation in engineering systems.
7. Analyze the ethical and social implications of engineering decisions in relation to sustainability.

Module Objectives/ Desired Learning Outcomes - Skills

Students should be able to:

1. Apply sustainable design principles and methodologies to engineering projects, considering environmental, social, and economic factors.
2. Utilize systems thinking approaches to analyze and optimize the environmental performance of engineering systems and processes.
3. Evaluate and implement energy-efficient and resource-conserving strategies in engineering design and operations.
4. Integrate renewable energy sources and sustainable materials into engineering solutions to minimize environmental impact.
5. Conduct life cycle assessments (LCAs) to evaluate the environmental and social impacts of engineering projects.
6. Employ data analysis and modeling techniques to optimize sustainability performance in engineering decision-making.
7. Collaborate effectively in multidisciplinary teams to develop and implement sustainable engineering solutions.
8. Communicate effectively, both orally and in writing, about sustainable engineering concepts, designs, and solutions to diverse stakeholders.

Module Objectives/ Desired Learning Outcomes - Competences

Students should be able to:

1. Apply a systems thinking approach to understand the complex interdependencies between engineering systems and sustainability challenges.
2. Demonstrate a deep understanding of the principles and practices of sustainable development and their application in engineering contexts.
3. Integrate knowledge from various disciplines, such as engineering, environmental science, and social sciences, to develop comprehensive and innovative sustainable engineering solutions.
4. Exhibit critical thinking and analytical skills to evaluate the environmental, social, and economic impacts of engineering decisions and propose sustainable alternatives.
5. Foster a collaborative and inclusive mindset to work effectively in multidisciplinary teams, leveraging diverse perspectives and expertise.
6. Demonstrate ethical awareness and responsibility in decision-making processes, considering the long-term environmental and social consequences of engineering activities.
7. Communicate effectively and persuasively about sustainable engineering concepts, solutions, and their benefits to stakeholders from different backgrounds.
8. Engage in lifelong learning and professional development to stay updated on emerging sustainability trends, technologies, and best practices in the field of engineering.

Content

The content of the module "Sustainable Engineering" focuses on exploring the principles and practices of sustainable development in engineering. It covers a wide range of topics

related to environmental, social, and economic sustainability in engineering processes and systems. The module aims to equip students with the knowledge and skills to address sustainability challenges and make informed decisions that balance technological advancements with long-term environmental and societal well-being.

The module includes the following topics:

1. Introduction to social and political requirements such as the "European Green Deal"
    - Adaptation of industrial processes regarding the desired degree of adaptivity to a then increasing variance of input materials in industrial value creation.
    - Strategies such as re-manufacturing not only offer ecological potential, but also bring about an increase in resilience and thus open new economic business perspectives.
    - suitable disassembly systems including dismantling abilities for the circular economy
    - Adaptive automated disassembly is the key enabler for this. Enabling technologies such as the use of sensors, AI or "design for disassembly", serve to implement this.
    - standardization is necessary to make data from production, from the user cycle and from automated condition assessments available and usable as a decision-taking foundation for adaptive processes
2. Introduction to Sustainable Engineering:
    - Understanding the concept of sustainability and its relevance to engineering.
    - Exploring the principles and goals of sustainable development.
    - Examining the role of engineering in achieving sustainable solutions.
3. Environmental Sustainability in Engineering:
    - Assessing the environmental impact of engineering activities.
    - Studying life cycle assessment (LCA) methodologies.
    - Exploring strategies for pollution prevention and waste management.
    - Analyzing resource conservation and energy efficiency in engineering systems.
4. Social and Ethical Considerations:
    - Recognizing the social and ethical dimensions of engineering projects.
    - Examining the social impacts of engineering solutions on communities.
    - Understanding ethical responsibilities and professional codes of conduct.
    - Addressing social equity, inclusivity, and cultural considerations in engineering.
5. Sustainable Design and Innovation:
    - Integrating sustainability principles into the design process.
    - Applying sustainable design strategies and techniques.
    - Exploring eco-design, green materials, and renewable energy technologies.
    - Analyzing case studies of sustainable engineering solutions.
6. Sustainable Manufacturing and Operations:
    - Implementing sustainable practices in manufacturing processes.
    - Assessing energy-efficient production methods and waste reduction strategies.
    - Examining sustainable supply chain management and green logistics.

- Investigating circular economy principles in engineering systems.

Throughout the module, students may engage in practical exercises, case studies, group discussions, and projects that enable them to apply sustainable engineering principles to real-world challenges. By the end of the module, students should have a comprehensive understanding of sustainable engineering principles, practices, and their applications in various engineering disciplines.

Recommended literature

- Schmitt, R. H.; et all: Closing the Loop with Automated Adaptive Disassembly. In Conference Proceedings AWK23, Empower Green Production, 11.12. May 2023; Aachen, P. 61-89; doi: 10.24406/publica-943
- Stark, Rainer ; Seliger, Günther ; Bonvoisin, Jérémy: Sustainable Manufacturing : Challenges, Solutions and Implementation Perspectives. Berlin, Heidelberg: Springer, 2017. -ISBN 978-3-319-48514-0. S. 1-283