M.Sc.

Hydrogen Technology

Dean of Studies: Prof. Dr.-Ing. Johannes Völkl

Valid for winter semester 2026

(SPO 20231)

Module catalogue

This version is under constant development by the responsible lecturer. It is applicable to lectures, lab or computer courses. All regulations and provisions are in accordance with the university study regulations.

approved by the Faculty Council on 24th of June, 2026

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Study and examination regulations

The current valid study and examination regulations of the University of Applied Science Rosenheim can be found on the homepage:

https://www.th-rosenheim.de/home/infos-fuer/studierende/studienorganisation/formalia/studienregelungen/studien-und-pruefungsordnungen/

Programme content and organization

Programme description

The reduction of climate gases and the establishment of a sustainable economy is a common goal of both politics and society. Especially, the chemical industry will encounter a huge transformation when process routes switch to sustainable energy and raw materials. Certainly, this development is not limited to this industry but will effect all sectors.

The master's programme Hydrogen Technology is developed to give students an application-oriented education focused on Hydrogen. The goal is to deepen and specialize one's knowledge in production, storage, transport and application of Hydrogen, and related fields. The programme offers modules to gain in-depth technological as well as applied and competence-oriented knowledge. The theoretical base is supplemented with a project within the area of Hydrogen Technology and current challenges of applied research and development projects.

To achieve this goal the programme is organized as a combination of compulsory fundamental modules; specialization modules with a stronger theoretical background; application and competence-oriented modules; as well as a project thesis including a project seminar. The programme is completed with a master's thesis.

All students must take the compulsory modules HTF 01 “Fundamentals of Hydrogen and Safety” and HTF 02 “Scientific methods and writing.” This corresponds to 10 CP.

From the Specialization and Application & Competence-oriented Elective Modules a total of 40 CP must be earned to complete the programme. One must select at least 10 CP from the Specialization group and 10 from the Application & Competence-oriented group. The modules and their assignment to these groups are summarized in this module handbook and may be updated by the faculty board.

The theoretical foundation is supplemented by a project thesis, with an accompanying project seminar, on topics from the area of Hydrogen Technology and current challenges of applied research and development projects. This corresponds to 10 CP.

The independent and creative application of knowledge on a problem from Hydrogen Technology is demonstrated in the master's thesis at the end of the programme. The thesis is worth a total of 30 CP.

Upon request, other modules from the range of courses offered by Rosenheim Technical University of Applied Sciences or other universities can also be selected and credited as required elective modules. The Examination Committee decides on the request and the allocation as a specialist required or application and skill-oriented required elective module.

Recommended programme organization

Table 1: Recommended programme organization

Semester	Module number	Module name	Module group	CP
1	HTF 02	Scientific Methods and Writing	Compulsory	5
	HTS		Specialization	10
	HTS		Application & Competence-oriented	10
2	HTF 01	Fundamentals of Hydrogen and Safety	Compulsory	5
	HTS		Specialization	10
	HTS		Application & Competence-oriented	10
	HTM 01	Project Thesis		10
3	HTM 02	Master’s Thesis		30
Total				**90**

At least 10 CP must be earned from the module group “Specialization.”

At least 10 CP must be earned from the module group “Application & Competence-Oriented.”

In total, 40 CP must be earned from the groups “Specialization” and “Application & Competence-Oriented.”

Elective modules

In the following the modules, which can be selected in the "Hydrogen Technology" master's programme are listed. Besides the compulsory courses the courses are classified into the following groups:

- Specialization
- Application & Competence-Oriented

The course listed in Table 2 and 3 show the current classification of courses and whether the course is being held in summer or winter semester.

In accordance with §5 of the study regulations, it is possible to select courses from the catalogue of the University of Applied Science Rosenheim or other Universities, which are not listed in Table 2 and 3. This selection must be approved by the programme's examination board. The approval must be carried out for each student individually. These courses must match the technical and academic profile of the "Hydrogen Technology" master's programme. Students receive information from the examination board in advance, if the selection is approvable. The corresponding application for approval can be found on the homepage of the master's programme.

Table 2: Module list in winter term

Module		Compulsory group	Specialization group	Application & Competence-oriented group
HTF 01	Fundamentals of Hydrogen and Safety	**X**		
HTS 01	Chemical H_2 Conversion: Applications and Industrial processes			**X**
HTS 02	Homogeneous Catalysis			**X**
HTS 06	Hydrogen Storage, Transport and Distribution Systems		**X**	
HTS 09	Energy Technologies			**X**
HTS 11	Computational Fluid Dynamics for Process Industry		**X**	
HTS 12	Membrane Technologies		**X**	
HTS 13	Heterogeneous Catalysis			**X**
HTS 17	Sustainability and Economics		**X**	
HTS 18	Quality management			**X**
HTS 19	Materials for Hydrogen Applications		**X**	
HTS 20	Robotics and AI			**X**

Table 3: Module list in summer term

Module		Compulsory group	Specialization group	Application & Competence-oriented group
HTF 02	Scientific Methods and Writing	**X**		
HTS 04	Advanced Thermodynamics for Hydrogen Applications		**X**	

HTS 05	Sources and Generation of Hydrogen	X	
HTS 03	Energy Politics and Laws		X
HTS 07	Electrochemical Process Engineering	X	
HTS 08	Techno-economic Analysis and Simulation		X
HTS 10	Introduction to the Economics of Hydrogen Markets		X
HTS 14	Carbon Management	X	
HTS 15	Project Management		X
HTS 16	Chemistry of Renewable Resources	X	

Regulations and Provisions

Project thesis with project seminar

Potential topics for the project thesis can be found in the Learning Campus or can be discussed directly with the supervisor. In addition, carrying out the project thesis at a company is possible. A summary of the regulations and provisions is shown in Table 4.

Table 4: Regulations and provisions for the project thesis

Topic generation	A list of project topics is given in the learning campus or can be discussed directly with the potential supervisor. Details and the specific scope are to be discussed with the supervisors. A project thesis at a company is possible. Here, two supervisors from the university are required. The scope of the thesis should be discussed prior to the start in a kick-off meeting between the student, the company and the supervisor of the university.
Thesis application	The student has to apply for the allocation of the topic to the regulation board after the student and the supervisor agree on a topic and its scope. The application form is in the learning campus. The application procedure is shown in Figure 1.
Requirement for the topic and content	Within the project thesis the student should work on a topic of ongoing research and development withing the area of Hydrogen Technology. Those topics can have a direct relation to Hydrogen or other challenges originating from the transformational processes in industry. If a topic is selected which is processed outside of the university (e.g. in a company) it is highly recommended to discuss the outline of the thesis with the examiner before the project starts to align on the content and the goal of the thesis. For the evaluation and grading of the thesis the following points are taken into account: • Formal structure and layout of report and presentation • Self-motivation and engagement • Innovative character of topic • Relevance for research and industry of the topic within Hydrogen Technology and transformation goals
Duration	After admission of the topic by the regulation board the maximum duration is 5 month from the date of the admission.

Examiner	The student nominates an examiner and a second assessor for the project thesis in the application process. The nomination is approved by the examination board. The examiner is responsible for the assessment of the project thesis.
Examinations	The project thesis consists of one Admission Requirement and two successful examinations. • Oral Examination: after completion of the tasks of the project thesis the results are presented. This examination consists of 20 minutes of presentation and 10 minutes of discussion. The examination is held after completion, the date will be determined together with examiner. It has to be within the maximum duration period of the project thesis. As an alternative, the presentation can also be given as part of an academic or technical conference in the presence of the examiner. • Written project thesis: the thesis is submitted as a written scientific report. The submission deadline is defined in the application form for the project topic. The deadline is 5 month after the date of the admission of the topic. The report should be submitted in a digital format such as a pdf-file. • Weight of the grade: 90 % written report / 10 % oral examination. • In the final grading report only the combined final grade will be included

Student is looking for a topic
↓
Student looks into the topic list in the Learning Campus
↓
Student contacts the corresponding supervisor to discuss a possible topic and its objectives
↓
Student presents the topic and objectives

Participation is Admission Requirement!

↓
Student fills out the application form including topic and name of supervisors
↓
Student collects the signature from the supervisors for the application form
↓
Student hands in the form to the Examination Office Burghausen
↓
Examination Office hands over the application form to the Examination Board
↓
Examination Board admits the thesis
↓
Student conducts the thesis (290 h) with a maximum duration of 5 months
↓
Student presents the results (20 min + 10 min)
↓
Student hands in a written report to the supervisors (pdf-format)
↓
Supervisor fills out the grade form and hands it to the Examination Office
↓
Grade is entered into OSC

Figure 1: Process for application and subsequent procedures for the Project Thesis

Module catalogue

Compulsory Modules

HTF 01: Fundamentals of Hydrogen and Safety

Module Responsible	Prof. Dr.-Ing. Patrick Preuster
Lecturer	Prof. Dr.-Ing. Patrick Preuster, tbd
Module Group	Compulsory
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	Mandatory subject in HYT-Master
Course Type	• Lecture: 80% • Practical Course: 20%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Learning Goals	After the course students • understand the thermodynamic characteristics of hydrogen • understand are able to describe physical hydrogen storage technologies e.g. liquefaction and compression • are able to conduct a risk assessment on hydrogen-based applications and know how to handle typical risks and evaluate hazards • know general methods of hydrogen generation • know the different technologies of hydrogen storage and transportation
Content	• Repetition of (chemical) engineering fundamentals

	• Fundamental properties of Hydrogen • Thermodynamic characteristics of Hydrogen and its applications • Safety topics regarding the handling, storage and transport of Hydrogen • Overview of hydrogen generation methods
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulations (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTF 02: Scientific Methods and Writing

Module Responsible	Prof. Dr.-Ing. Johannes Völkl
Lecturer	Oscar Rojas, Sania Baars, Prof. Dr. Dorottya Kriechbaumer, Prof. Dr. Manuela List, Prof. Dr.-Ing. Patrick Preuster, Prof. Dr. Dominik Pentlehner, Prof. Dr.-Ing. Johannes Völkl, Prof. Dr.-Ing. Johannes Lindner, Prof. Günter Modzel
Module Group	Compulsory
Module Duration	1 semester
Term	Summer
Applicability of the module in the degree program	
Course Type	• Lecture: 10% • Practical Course: 90%
Credit Points (ECTS)	5
Weekly Working Hours	
Total Workload	150 hours
Prerequisites	
Number of Participants	Limited (180) Enrollment requires in-person signing of a list. If the number of interested students exceeds the maximum number the seats will be awarded based on the following order of criteria: 1. Study semester 2. Amount of Credit Points 3. Current Average Grade
Learning Goals	After the module students • know how a scientific text has to be structured • know different types of citation • are aware of different approaches in different journals in the field of natural science and engineering • are able to summarize a scientific text and present these results

	• apply the knowledge in scientific texts like the project thesis or master thesis in the future

Content	The lecture is structured in the following phases:
	• Signing up for enrollment
	• Introduction session with theoretical background on scientific writing and presentation
	• Splitting in small groups under the supervision of one lecturer
	• Receiving a scientific text
	• Preparing a presentation, which should consist of
	  ○ Summary of the content of the text
	  ○ Presentation and visualization of the underlaying theoretical background and the proposed results
	  ○ Presentation should consist information taken directly from the scientific text as well as from additional sources
	  ○ Presentation has to follow all standards of scientific presentations
	• Presenting in front of the supervisor
	• Fill out at least 5 feedback questionnaire → attending presentations of other students

Material	Lecture notes as downloadable files (learning campus)
Examination	The examination is the presentation of the theoretical background and results of the handed out scientific text from a chosen topic
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTM 01: Project Thesis with Project Seminar

Module Responsible	Prof. Dr.-Ing. Johannes Völkl	
Lecturer	Nominated by the examination board	
Module Group	Compulsory	
Module Duration	1 semester	
Term	Winter	
Applicability of the module in the degree program	Mandatory subject in HYT-Master	
Course Type	Project thesis with presentation in a project seminar	
Credit Points (ECTS)	10	
Weekly Working Hours		
Total Workload	Total	300 hours
	Project thesis work:	290 hours
	Seminar with own presentation:	10 hours
Prerequisites	None	
Learning Goals	The learning goals should include the following competencies as defined by “Qualifikationsrahmen für die Deutschen Hochschulabschlüsse” for master’s programs in Germany: • Instrumental Competencies Knowledge and understanding as well as competencies for solving problems in new situations • Systemic competencies ○ Dealing with complex challenges ○ Making decisions based on academic and scientific principles, even under uncertainties ○ Acquiring new knowledge independently ○ Working independently on an extensive academic and scientific topic • Communication competencies	

	◦ Present one's own scientific conclusions to an audience of experts and non-experts in a clear and meaningful way ◦ Discuss scientific topics, challenges and ideas with experts and non-experts The project report and presentation are supporting the general study goal of generating and deepening language, presentation and communications skills. Collaborative skills are trained by working on a scientific topic with other people and discussing challenges and results within a project team.
Content	• Literature research • Definition of the problem to be solved • Planning of experiments and steps to solve the problem • Experimental work and/or academic research • Preparation of a project report and a project presentation
Material	Material provided by the supervisor, own research
Examination	The project thesis consists of one Admission Requirement and two successful examinations. • Oral Examination: after completion of the tasks of the project thesis the results are presented. This examination consists of 20 minutes of presentation and 10 minutes of discussion. The examination is held after completion, the date will be determined together with examiner. It has to be within the maximum duration period of the project thesis. As an alternative, the presentation can also be given as part of an academic or technical conference in the presence of the examiner. • Written project thesis: the thesis is submitted as a written scientific report. The submission deadline is defined in the application form for the project topic. The deadline is 5 month after the date of the admission of the topic. The report should be submitted in a digital format such as a pdf-file. • Weight of the grade: 90 % written report / 10 % oral examination.

	• In the final grading report only the combined final grade will be included
Literature	

HTM 02: Master's Thesis

Module Responsible	Prof. Dr.-Ing. Johannes Völkl
Lecturer	Nominated by the examination board
Module Group	Compulsory
Module Duration	1 semester
Term	Winter / Summer
Applicability of the module in the degree program	Mandatory subject in HYT-Master
Course Type	Master's thesis
Credit Points (ECTS)	30
Weekly Working Hours	
Total Workload	Total 900 hours
Prerequisites	30 CP required to apply for a thesis topic (according to study regulations of the "Hydrogen Technology" master's program)
Learning Goals	The learning goals include the following competencies as defined by "Qualifikationsrahmen für die Deutschen Hochschulabschlüsse" for master's programs in Germany: • Instrumental Competencies Knowledge and understanding as well as competencies for solving problems in new situations • Systemic competencies ○ Dealing with complex challenges ○ Making decisions based on academic and scientific principles, even under uncertainties ○ Acquiring new knowledge independently ○ Working independently on an extensive academic and scientific topic • Communication competencies ○ Present one's own scientific conclusions to an audience of experts and non-experts in a clear and meaningful way

	○ Discuss scientific topics, challenges and ideas with experts and non-experts The report and presentation of the results of the master's thesis support the general study goal of acquiring and deepening language, presentation and communication skills. Collaborative skills are trained by working on a scientific topic with other people and discussing challenges and results within a project team.
Content	• Literature research • Definition of the problem to solve • Planning of experiments and steps to solve the problem • Experimental work and/or academic research • Preparation of a report and presentation
Material	Material provided by the supervisor, own research
Examination	• Oral Examination: The oral examination is a presentation of the thesis within the course's project seminar. This examination consists of 20 minutes of presentation and 10 minutes of discussion. The seminar date is assigned by the supervisor in coordination with the student. • Written thesis: The thesis is a written scientific report. The submission deadline is defined in the application form. The report is submitted via OSC platform of TH Rosenheim. • In accordance to the study regulations the ratio of the weight for the final grade is 90 % written report / 10 % oral examination
Literature	

Module Group: Specialization and Application & Competence-Oriented

HTS 01: Chemical H_2 Conversion: Applications and Industrial Processes

Module Responsible	Prof. Dr.-Ing. Johannes Völkl
Lecturer	Prof. Dr.-Ing. Johannes Völkl
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	MF 38 Chemical H2 Conversion
Course Type	• Lecture: 50% • Practical Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Basic knowledge in Chemistry, Thermodynamics and (Process) Modeling Prerequisite for Examination: Participation in first two in-class lectures
Number of Participants	Not limited
Learning Goals	After the module students • know different Hydrogen conversion routes to fuels and chemicals based on fossil feedstock • know different Hydrogen conversion routes to fuels and chemicals based on fossil feedstock • can compare those routes towards the same product based on different feedstock and identify common parts and differences in the processes • evaluate the impact of a transformation from a conventional route to a sustainable route

	• understand the material cycle of the chemical industry and apply this knowledge into the context of new developments • can select suitable technology parts, e.g. type of reactor, for new sustainable routes • understand the interconnection between availability of renewable energy, the supply with Hydrogen and supply with additional feedstock for Power-to-X processes • apply the knowledge in a case study with a Power-to-X process which includes the whole value chain from feedstock supply to production and compare the route to a conventional process • understand and evaluate options for sector coupling, e.g. coupling of steel mills with chemical production

Content	• Overview of Hydrogen conversion processes based on fossil feedstock as well as from renewable feedstock
	  ○ Methanol Synthesis
	  ○ Ammonia Synthesis
	  ○ Methanisation
	  ○ Fischer-Tropsch Synthesis
	  ○ Synthesis of C2-C4 alcohols
	  ○ Biomass conversion to fuels and chemicals
	  ○ H2 in steel production
	• Comparing of conventional routes and sustainable routes, e.g. Power-to-X, for above mentioned processes
	• Overview of the material cycle of fossil feedstocks to fuels and chemicals
	• Evaluation of the impact of the transformation towards sustainable production routes on those material cycles
	• Overview of different sources for all important components of the material cycle
	  ○ CO_2 capture
	  ○ N_2 separation

	• Introduction of economic and sustainability performance indicators • Case study on a selected example of a hydrogen conversion process (see "Examination")
Material	Lecture notes as downloadable files (learning campus)
Examination	The examination is carried out as a Case Study on a selected example of a hydrogen conversion process in a Power-to-X route. In the beginning of the semester the students select a topic and form groups. Based on a defined scope they should work out a report on this case study. This report will be graded. The case study is embedded in a scenario that such a plant should be built in Burghausen. This implies certain conditions for the power supply and other parts, which should be included in the report. The content of the case study consists of the following points: • Status Quo: o How is "X" produced currently? o What is the current global capacity o What is the main usage? o Draw and describe a flowsheet of the current process from raw material to product • New route o Select an alternative route for "X" o Describe what sustainable raw materials you would select (CO2 from point source or air capture, N2 from air, biomass,…) o Draw a flowsheet for the route o Calculate a rough mass and energy balance o What catalyst is used and how is the catalyst produced o Which type of reactor would you chose and why? o What is the required land usage for the power supply of your plant? (Select wind/sun or any other renewable source and evaluate the land usage)

	• Compare both routes • Include a bibliography with all used sources
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 02: Homogeneous Catalysis

Module Responsible	Prof. Dr. Dominik Pentlehner
Lecturer	Prof. Dr. Dominik Pentlehner
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	CI 134.2 Homogeneous catalysis; UT 34.2 Homogeneous catalysis
Course Type	• Lecture: 50% • Practical Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Profound knowledge in Chemistry both theory and practical (lab work)
Number of Participants	Limited (30 in practical course) Enrollment requirements and procedure will be announced via Learning Campus.
Learning Goals	• Overview and knowledge of catalytic methods in chemistry, e.g., heterogeneous, homogeneous, transition metal catalysis or organocatalysis • Understanding of the working principle (reaction mechanism) of homogeneous catalysts • Ability to run experiments under inert atmosphere
Content	• Definitions, advantages and disadvantages compared to other catalytic methods • Reaction mechanisms and experimental setups for homogeneous catalysis • Organometal-chemistry and transition metal catalysis • Organocatalysis • Stereoselective reactions

	• Photocatalysis
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter Overview: Breitmaier, E., Jung, G.: Organic Chemistry; Thieme

HTS 04: Advanced Thermodynamics for Hydrogen Applications

Module Responsible	Prof. Dr.-Ing. Johannes Völkl
Lecturer	Prof. Dr.-Ing. Johannes Völkl
Module Group	Specialization
Module Duration	1 semester
Term	Summer
Applicability of the module in the degree program	Specialization elective course in HYT-Master
Course Type	• Lecture: 50% • Practical Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Number of Participants	Not limited

Learning Goals	After the module students
	• have an advanced understanding of fundamental equations of thermodynamics and their interconnection with technical relevant properties, e.g. enthalpy, heat capacities, …
	• know calculation methods for thermodynamic properties of Hydrogen
	  ○ Ideal Gas Law
	  ○ Soave-Redlich-Kwong
	  ○ Peng-Robinson
	  ○ Group Contribution Methods
	• identify, when to use more sophisticated thermodynamic models instead of ideal equations
	• apply these concepts to relevant technical examples from Hydrogen technology
	  ○ liquefaction of CO_2 or H_2

	◦ chemical reactions with unknown or complex substances, e.g. hydrogenation of biomass ◦ compression and storage • know about different measurement approaches for specific thermodynamic properties and to derive parameters for corresponding thermodynamic equations
Content	• Repetition: Fundamental equation of Thermodynamics • Basic and advanced property methods • Derivation of expressions for technical relevant parameters from equation of states • Influence of selected property methods on calculation results for hydrogen and related components (e.g. CO_2, CH_4, …) • Comparison with results from group contribution methods • Thermodynamic calculations for parameters for liquefaction processes • Measurement approaches for the determination of thermodynamic properties • Fitting and determination of parameters for thermodynamic models • Discussion of technical realized technologies for H_2 and CO_2 liquefaction (Brayton cycle, Claude cycle, …) • Thermodynamic description of reactions and reaction equilibria • Application of different methods (equation of state, gE-models, group-contribution methods) for relevant reactions, e.g. hydrogenation of biomass
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter

HTS 05: Sources and Generation of Hydrogen

Module Responsible	Prof. Dr.-Ing. Patrick Preuster
Lecturer	Prof. Dr.-Ing. Patrick Preuster
Module Group	Specialization
Module Duration	1 semester
Term	Summer
Applicability of the module in the degree program	Specialization elective course in HYT-Master
Course Type	• Lecture: 50% • Practical Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Number of Participants	Not limited
Learning Goals	After the course students • know the different routes for hydrogen generation processes in depth • understand the advantages and disadvantages of each process route • are able to calculate mass- and energy balances for hydrogen generation processes • are able to select a suitable hydrogen generation process for a given downstream process based on different parameters • know the environmental impact of the different hydrogen generation process e.g. global warming potential
Content	• Overview of Hydrogen generation processes • Process routes of conventional Hydrogen production processes

	• Process routes of sustainable Hydrogen production processes • Comparing different electrochemical water splitting technologies • Comparison of Hydrogen generation processes
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 06: Hydrogen Storage, Transportation and Distribution Systems

Module Responsible	Prof. Dr.-Ing. Patrick Preuster
Lecturer	Prof. Dr.-Ing. Patrick Preuster
Module Group	Specialization
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	Specialization elective course in HYT-Master
Course Type	• Lecture: 60% • Practical Course: 40%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Number of Participants	Not limited
Learning Goals	After the course students • know the different methods for hydrogen storage • understand the advantages and disadvantages of each storage technology • are able to calculate mass- and energy balances for hydrogen storage methods • are able to calculate specific hydrogen storage and transportation costs for different technologies • are able to compare hydrogen storage technologies • are able to select a suitable hydrogen storage and transportation method • know the environmental impact of the different hydrogen generation process e.g. global warming potential

	• are able to apply the knowledge in lab practice e.g. in the hydrogenation and dehydrogenation of a chemical hydrogen carrier

Content	• Overview of Hydrogen storage and transport methods from a distribution and transportation point of view
	  ○ Ammonia
	  ○ Liquid hydrogen
	  ○ Gaseous hydrogen
	  ○ Ethers
	  ○ Acids
	  ○ Alcohols
	  ○ Liquid Organic Hydrogen Carriers
	  ○ Metal Hydrides
	  ○ Adsorption
	• Detailed discussion of selected storage methods
	• Detailed discussion of selected transport and distribution methods
	• Comparison of different methods to store and transport Hydrogen
	• Lab course in which the hydrogenation and dehydrogenation of a chemical hydrogen carrier is conducted

Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 07: Electrochemical Process Engineering

Module Responsible	Prof. Dr.-Ing. Patrick Preuster
Lecturer	Prof. Dr.-Ing. Patrick Preuster
Module Group	Specialization
Module Duration	1 semester
Term	Summer
Applicability of the module in the degree program	Specialization elective course in HYT-Master
Course Type	• Lecture: 50% • Practical Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Number of Participants	Not limited
Learning Goals	After the course students • understand electrochemical conversion processes • understand electrochemical catalysis • know different processes for electrochemical hydrogen generation as well as consumption • understand the concept of Co-electrolysis and are able to design a suitable process integration • are able to compare electrochemical process routes • are able to select suitable electrochemical conversion units for given process conditions apply the knowledge in a case study
Content	• Overview of electrochemical fundamentals • Overview of electrochemical process concept • Definitions of fundamental concepts in electrochemical processes

	• Water Electrolysis and Fuel Cell Application • Electrochemical CO_2 Reduction • Reactor and Process Concepts • Application of the knowledge in a lab course on a reversible PEM electrolyzer
Material	Lecture notes as downloadable files (learning campus)
Examination	The examination is carried out as a Case Study on a selected example for which an electrochemical process should be carried design and scaled appropriately. Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 08: Techno-Economic Analysis and Simulation

Module Responsible	Prof. Dr.-Ing. Johannes Völkl
Lecturer	Prof. Dr.-Ing. Johannes Völkl
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Summer
Applicability of the module in the degree program	MF 43 Techno-Economic Analysis and Simulation
Course Type	• Lecture: 50% • Practical Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Number of Participants	Not limited
Learning Goals	After the module the students • know the parts of a Techno-Economic Analysis • understand how to obtain required data for Techno-Economic Analysis • can compare different approaches to estimate CAPEX based on characteristic process data • know factors to quantify sustainability criteria of process routes • apply the learned concepts in an individual case study in which a Techno-Economic calculation is carried out • can use ASPEN Plus in the context of Techno-Economic Analysis
Content	• Fundamentals of economical process assessment • Calculation of CAPEX and OPEX for process routes • Evaluation of different CAPEX estimation approaches

	• Application of evaluation methods for sustainability criteria, e.g. greenhouse gas emissions • Overview of methods of conceptual process design • Comparison of different approaches for a Techno-Economic evaluation of process routes • Individual Case Study: Techno-Economic evaluation for a selected topic as examination project • Introduction to the usage of Process Simulation to generate data for Techno-Economic Analysis
Material	Lecture notes as downloadable files (learning campus)
Examination	The examination is carried out as a Case Study on a selected example for which a Techno-Economic evaluation should be carried out. The process set-up will be given, the students should apply the different methods for CAPEX and OPEX calculations they learned in the lecture. The required content for the report and the specific project topics are announced in the beginning of the semester in the lecture and Learning Campus.
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 09: Energy Technologies

Module Responsible	Prof. Dr.-Ing. Patrick Preuster
Lecturer	Prof. Dr.-Ing. Patrick Preuster
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	
Course Type	• Lecture: 80% • Practical Course: 20%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Number of Participants	Not limited
Learning Goals	After the module the students • know basic terms of the energy industry • know the impact of power generation on environment and climate • are able to explain the functioning and areas of application of the various technologies for power and heat generation, distribution and storage technologies • are able to demonstrate the links between energy generation and climate change • are able to identify key factors in the pricing of electricity, gas and heat • are able to make comparative assessments of the environmental impact of different technologies of energy generation • are able to carry out simple material/energy flow calculations for energy generation plants

	• are able to carrying out simple economic efficiency calculations for energy generation plants
Content	• Basic concepts of the energy industry • Reserves and resources of conventional energy sources • Statistics and forecasts of energy production and consumption • Energy and climate, energy policy programs • Thermal power generation (coal, gas, biogas, nuclear power plants, geothermal, solar thermal power plants) • Non-thermal power generation (hydropower, wind power, photovoltaics) • Electricity distribution and storage
Material	Lecture notes as downloadable files (learning campus)
Examination	The examination is carried out as a Case Study on a selected example for which an conventional and a renewable energy production or storage method should be compared regarding certain KPIs e.g. GHP. Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 10: Introduction to the Economics of Hydrogen Markets

Module Responsible	Prof. Dr. Jan Lüken
Lecturer	Prof. Dr. Jan Lüken
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Summer
Applicability of the module in the degree program	
Course Type	• Lecture: 50% • Practical Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	none
Number of Participants	Not limited
Learning Goals	Upon completion of this course, students will be able to: • Articulate the economic, social, and environmental underpinnings of the hydrogen economy. • Analyze the challenges and opportunities of hydrogen in an economic context, especially regarding the green transformation in Germany and Europe. • Evaluate the role of policy and regulation in shaping the hydrogen market and its integration into existing energy systems. • Develop informed perspectives on the future of hydrogen as a key component of global energy transitions.
Content	• Economic Evaluation: Apply economic principles and models to assess the feasibility, sustainability, and market potential of hydrogen technologies and initiatives. This includes understanding cost structures, pricing mechanisms, and financial incentives.

	• Policy and Regulatory Insight: Analyze the impact of policy and regulation on the hydrogen economy, identifying how governmental frameworks can support or hinder economic viability and market development. • Market Analysis: Understand the dynamics of the hydrogen market, including supply and demand factors, market segmentation, and the role of international trade in hydrogen economics. • Strategic Thinking and Business Modelling: Formulate strategies to navigate economic and regulatory barriers in the development of the hydrogen economy, with an emphasis on identifying economic opportunities and creating value in emerging hydrogen markets.
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter - Heuser, P. M., Ryberg, D. S., Grube, T., Robinius, M., & Stolten, D. (2019). Techno-economic analysis of a potential energy trading link between Patagonia and Japan based on CO2 free hydrogen. *International journal of hydrogen energy*, *44*(25), 12733-12747 - Schippert, J., Runge, P., Farhang-Damghani, N., & Grimm, V. (2022). Greenhouse gas footprint of blue hydrogen with different production technologies and logistics options. *Available at SSRN 4153724*. - Robinius, M., Cerniauskas, S., Madlener, R., Kockel, C., Praktiknjo, A., & Stolten, D. (2022). Economics of Hydrogen. In The Palgrave Handbook of International Energy Economics (pp. 75-102). Cham: Springer International Publishing.

HTS 11: Computational Fluid Dynamics for Process Industry

Module Responsible	**Prof. Dr.-Ing. Johannes Lindner**
Lecturer	Prof. Dr.-Ing. Johannes Lindner
Module Group	Specialization
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	Specialization elective course in HYT-Master
Course Type	• Lecture: 50% • Practical Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering including basics in mathematics and fluid mechanics
Number of Participants	Limited (30) Requirement is appropriate prior knowledge, documented by passing of the module HTS 04: Advanced thermodynamics for hydrogen applications. Enrollment requirements and procedure will be announced via Learning Campus.
Learning Goals	After the course students • understand the limitations of CFD • know the basics of computational fluid dynamics • can design, model and mesh • can simulate flow of gas and reactions including gas • can apply CFD to applications in hydrogen technology
Content	• Introduction and overview of simulation approaches • Overview of computational fluid dynamics • Finite Volumes Meshing • Navier-Stokes-equations for CFD

	• Numerical solving of equations • Evaluation and presentation of simulation results • Short introduction to selected other simulation methods
Material	Lecture notes as downloadable files (learning campus)
Examination	The students create a project study thesis on a individual CFD-simulation of a process linked to hydrogen technology. Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 12: Membrane Technologies

Module Responsible	**Prof. Dr.-Ing. Angela Klüpfel**
Lecturer	Prof. Dr.-Ing. Angela Klüpfel
Module Group	Specialization
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	Specialization elective course in HYT-Master
Course Type	• Lecture: 75% • Practical Course: 25%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Chemistry and (chemical) engineering fundamentals, including (chemical) lab work experience
Number of Participants	Limited (16) Enrollment requirements and procedure will be announced via Learning Campus.
Learning Goals	After the course students • Understand fundamentals of mass transport, advantages and limitations of membrane processes in different applications • Can discuss recent developments in membrane materials and membrane processes supporting emission control, circularity, resource efficiency, and hydrogen applications • Can plan and perform basic screening experiments for a given separation challenge • Can roughly design a membrane based process combination by assessment of starting point and objective, derivation of pretreatment requirements,

	evaluation of experimental results and estimation of process parameters • Can apply membrane technologies to applications in hydrogen technology
Content	• Overview on membrane applications • Membrane technology fundamentals (driving forces, mass transport, materials, preparation) • Membrane modules, process design and operation • Characterization methods • Recent developments and case studies • Membrane based applications discussed in the course will include e.g.: water and waste water treatment, resource recovery, industrial liquid and gas separation processes, fuel cells and electrolysis • The practical part consists of a case study in the field of membrane applications in aqueous environments which includes literature search, lab experiments and process design.
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 13: Heterogenous Catalysis

Module Responsible	**Prof. Dr. Dorottya Kriechbaumer**
Lecturer	Prof. Dr. Dorottya Kriechbaumer
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	Application & Competence-Oriented elective course in HYT-Master
Course Type	• Lecture: 75% • Practical Course: 25%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Profound knowledge in chemistry (thermodynamics, reaction kinetics), practical experience in laboratory work
Number of Participants	Unlimited In WS 23/24: Optional lab course, group size and group organization will be announced in the lecture
Learning Goals	The students gain an: • Overview of heterogeneous catalysis and relevance in the chemical industry • Understanding the kinetics of heterogeneous catalysis • Understanding the design, preparation and characterization methods of catalysts • Insight into the process engineering of heterogeneous catalysis and typical reactors • Insight to application for power-to-hydrogen, and hydrogen-to-power solutions
Content	• Definition, fundamentals and comparison to other catalytic methods • Surface reactions

	- Reaction kinetics, reaction mechanism - Types of catalysts - Catalyst preparation, characterization and degradation - Life cycle of a catalyst - Catalytic process engineering - Introduction of electrocatalysis and photocatalysis
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 14: Carbon Management

Module Responsible	**Prof. Dr.-Ing. Patrick Preuster / Prof. Dr.-Ing. Johannes Völkl**
Lecturer	Prof. Dr.-Ing. Patrick Preuster / Prof. Dr.-Ing. Johannes Völkl
Module Group	Specialization
Module Duration	1 semester
Term	Summer
Applicability of the module in the degree program	Specialication elective course in HYT-Master
Course Type	• Lecture: 75% • Practical Course: 25%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Basic knowledge in Chemistry, Thermodynamics and Chemical Engineering Prerequisite for Examination: Participation in first two in-class lectures
Number of Participants	Unlimited
Learning Goals	The students gain an: • Overview of sources of CO_2 • Understanding technical challenges for the separation of CO_2 • Insight into applications (Carbon Capture and Utilization CCU) or storage (Carbon Capture and Storage CCS) of CO_2 • Overview of regulations and legal frameworks related to Carbon Management • Introduction to economic aspects of Carbon Management, e.g. certificate trading

	• Detailed insights into general separation technologies and specific technical estimation of CO_2 separation processes
Content	• Origin of CO_2 in natural and technical processes, differences in concentration, composition and amount • Technical separation principles • Definition of CCU and CCS with application examples • Legal frameworks related to Carbon management • Influence of regulations on the technical development of CO_2 separation and application • Economic approaches, e.g. certificate trading, to support a carbon management strategy
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 15: Project Management

Module Responsible	**Prof. Dr. Günter Modzel**
Lecturer	Prof. Dr. Günter Modzel
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Summer
Applicability of the module in the degree program	Application and competence oriented elective course in HYT-Master
Course Type	• Lecture: 80% • Practical Course: 20%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	None
Number of Participants	Limited (30) Enrollment requirements and procedure will be announced via Learning Campus.
Learning Goals	Understanding the theoretical concept of project management. Becoming familiar with the real life challenges of project management.
Content	• Basic concept of project management • Project management tools • Problems of project management
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 16: Chemistry of renewable resources

Module Responsible	**Prof. Dr. Dominik Pentlehner,** Prof. Dr. Manuela List
Lecturer	Prof. Dr. Dominik Pentlehner, Prof. Dr. Manuela List
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Summer
Applicability of the module in the degree program	MF37 chemistry of renewable resources
Course Type	• Lecture: 75% • Practical Course: 25%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Profound knowledge in Chemistry both theory and practical (lab work)
Number of Participants	Limited (20 in practical course) Enrollment requirements and procedure will be announced via Learning Campus.
Learning Goals	• overview and knowledge about the chemistry of renewable resources. Different types of resources, pathways, applications • definitions, advantage and disadvantages compared to fossil raw materials, pathways for renewable resources, applications
Content	• Biorefinary: from renewable resources to chemicals and pharmaceeuticals • Chemical modifications of chemicals from renewable resources, e.g. Celluloseacetate • Bulk chemicals from renewable resources” • Biopolymers

	• Fats and oils • Carbohydrates • Lignin • Amino acids and proteins • Others, e.g. terpenoids, vitamins”
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter

HTS 17: Sustainability and Economics

Module Responsible	**Prof. Dr. Andreas Fieber**
Lecturer	Prof. Dr. Andreas Fieber
Module Group	Specialization
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	
Course Type	• Lecture: 50% • Practical Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	None
Number of Participants	Limited (20 in practical course) Enrollment requirements and procedure will be announced via Learning Campus.
Learning Goals	Upon completion of this course, students will be able to: • Students master the basics of the concept of sustainability. • They are familiar with the most important global agreements on this topic. • They will recognise and reflect on the reasons for the need for a global transformation of social and economic systems towards greater sustainability. • Students will recognise the economic challenges and opportunities arising from the global transformation towards greater sustainability. General qualification goals: • Students can independently analyse issues related to sustainability, present them

	professionally and summarise them in a scientific paper.
Content	• Sustainability is a megatrend in the 21st century and will have a significant impact on the economy and society worldwide. The three dimensions of sustainability are economy, ecology and social issues. Sustainability. • Concepts of sustainability, especially based on the economy within the framework of planetary boundaries • Fundamental global agreements: Sustainable Development Goals (SDGs), Paris Agreement • Status of implementation from a global perspective • Measures and status of implementation in individual countries: USA, EU-27, Germany, India, Pakistan, or a country of their choice. These are presented as part of the examination papers.
Material	Lecture notes as downloadable files (learning campus)
Examination	The students choose several topics. They are then assigned a topic. They will give a presentation on this topic. Furthermore, they prepare a written paper that fulfils academic requirements: E.g. research question, citations and footnotes, bibliography. Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	• Fieber, A. (2024), Handbuch Nachhaltigkeit. Ziele, Klimawandel, Politik, München, Tübingen. Link: https://www.narr.de/handbuch-nachhaltigkeit-46297/ • Ritchie, H. (2024). Not the End of the World: How We Can Be the First Generation to Build a Sustainable Planet. Little, Brown Spark Verlag,

New York. Link: https://www.nottheendoftheworld.co.uk/?utm_source

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- Hinton, J., & Maclurcan, D. (2019). How on Earth: Flourishing in a Not-for-Profit World by 2050. Post Growth Institute Verlag, Ashland. Link: https://arxiv.org/abs/1902.01398
- Hawken, P. (Ed.). (2017). Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming. Penguin Books Verlag, New York. Link: https://www.penguinrandomhouse.com/books/549348/drawdown-by-edited-by-paul-hawken/
- Kolbert, E. (2014). The Sixth Extinction: An Unnatural History. Henry Holt and Company Verlag, New York. Link: https://www.amazon.com/Sixth-Extinction-Unnatural-History/dp/0805092994?utm_source
- Grober, U. (2012). Sustainability: A Cultural History. Green Books Verlag, Cambridge. Link: https://www.amazon.com/Sustainability-Cultural-History-Ulrich-Grober/dp/0857840452

HTS 18: Quality management

Module Responsible	**Prof. Dr. Günter Modzel**
Lecturer	Prof. Dr. Günter Modzel
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	Application and competence oriented elective course in HYT-Master
Course Type	• Lecture: 80% • Practical Course: 20%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	None
Number of Participants	Enrollment requirements and procedure will be announced via Learning Campus.
Learning Goals	Understanding the theoretical concept of quality management. Becoming familiar with the real life application of quality management.
Content	• Basic concept of quality management • ISO 9001 • Application of quality management in an industrial environment
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 19: Materials for Hydrogen Technologies

Module Responsible	**Prof. Dr. Manuela List**
Lecturer	Prof. Dr. Manuela List
Module Group	Specialization
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	Specialization elective course in HYT-Master
Course Type	• Lecture: 75% • Practical Course: 25%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Basic knowledge of materials science, chemistry, and engineering mechanics, including lab work experience
Number of Participants	Limited (20) Enrollment requirements and procedure will be announced via Learning Campus.
Learning Goals	After the course students • understand the interaction of hydrogen with metallic and polymeric materials • know the relevant material properties and characteristic values for hydrogen applications • are able to select suitable materials for hydrogen storage, transport and utilization systems • understand degradation mechanisms such as hydrogen embrittlement, permeation and corrosion • know experimental methods for the characterization of hydrogen-related material properties • are able to assess material failures and identify relevant damage mechanisms

	• understand the role of standards and design codes for hydrogen components • gain an overview of modern approaches for materials development and property prediction
Content	• Review of fundamental materials science and engineering • Material properties and characterization methods • Hydrogen-material interactions • Hydrogen embrittlement mechanisms (HELP, HEDE, hydride formation) • Metallic materials for hydrogen applications • Polymers, elastomers and sealing materials • Materials for hydrogen storage, transport and conversion systems • Experimental characterization and testing methods • Failure analysis and damage mechanisms • Standards and codes for hydrogen systems (e.g. ASME, ISO, DIN) • Materials development and computational materials engineering
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures

HTS 20: Robotics and AI

Module Responsible	**Prof. Dr.-Ing. Arno Bücken**
Lecturer	Prof. Dr.-Ing. Arno Bücken
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree program	Application and competence oriented elective course in HYT-Master
Course Type	• Lecture: 50% • Practical Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Programming skills are helpful but not compulsory
Number of Participants	Limited (12) Enrollment requirements and procedure will be announced via Learning Campus.
Learning Goals	In the lecture, students learn the fundamentals of both mobile and industrial robotics. Specifically, they are introduced to robot modeling, kinematics, kinematic and dynamic simulation, map generation, obstacle avoidance, and other techniques. Two programming languages for industrial robots are examined as examples. AI is considered here in the context of device control rather than generative AI; while generative AI will enable future human-machine interfaces, the focus here is primarily on the underlying control systems. Students are introduced to relevant techniques, particularly supervised learning. In the accompanying practical course, students deepen their understanding by implementing simple tasks on industrial robots and developing a simplified autonomous, intelligent mobile robot system including sensor control.
Content	• Description and simulation of industrial robots

	◦ Homogeneous transformations ◦ DH parameters ◦ Kinematics ◦ Kinematic and dynamic simulation • Programming of industrial robots using KRL and Blockly as examples • Mobile robots ◦ Mobile robot kinematics ◦ Collision avoidance ◦ Map generation ◦ Self-localization ◦ SLAM ◦ Planning Practical course content: • Control of robot arms using KRL and Blockly • Implementation of an autonomous system
Material	Lecture notes as downloadable files (learning campus)
Examination	Admission requirements, type and duration according to Study Regulation (SPO), updated at the beginning of each term, announcements published by the examination office
Literature	Specific literature for each chapter, current papers, will be announced during lectures
Note	This course is offered bilingual for bachelor students in German and master students in English according to the Rosenheim Award for Excellence in Teaching. This means: Lectures are in German, but will be translated simultaneously into English. Content will be identically, but with some parts as a bonus chapter for the bachelor students. In the practical course master students will receive a different task.