M.Sc.

Hydrogen Technology

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

Valid for students starting the program winter semester 2023/2024

(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 September 10, 2023‘

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1 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/

2 Programme content and organization

2.1 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.

2.2 Recommended programme organization

Table 1: Recommended programme organization

Semester	Module number	Module name	Module group	CP
	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."

3 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**

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**

4 Regulations and Provisions

4.1 Project thesis with project seminar

A list of possible project topics is provided in the learning campus. The student contacts supervisors early to discuss details of the topic and to define the scope of the work. The start of a topic not present on the list is possible. All project theses deal with challenges in the field of Hydrogen Technology. 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. Details and the specific scope are to be discussed with the supervisors. The title does not need to be in the project list.
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.
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 with project seminar consists of one Admission Requirement and two successful examinations. • Admission Requirement: after discussing the topic and the objective with the desired supervisor, these topics are presented to the other students in a seminar. The admission requirement consists of the presentation and the participation in these seminars. The dates will be communicated in the learning campus. • 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 should be in the semester term in which the project thesis was started. The report should be submitted in a digital format such as a pdf-file.

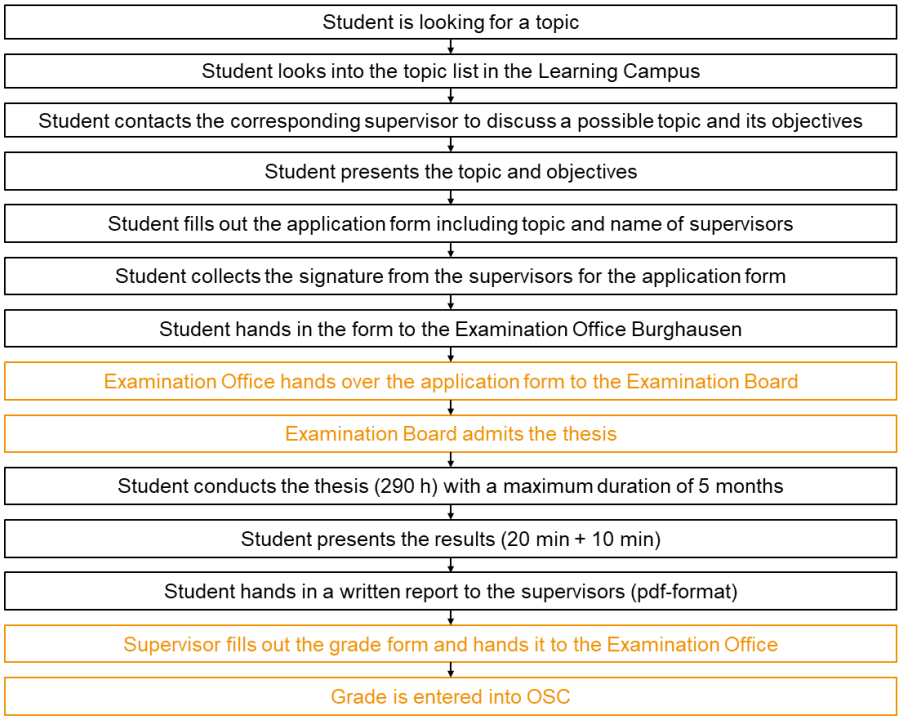

Figure 1: Process for application and subsequent procedures for the Project Thesis

4.2 Record of attendance

In accordance with the study regulations, there is compulsory attendance for the following modules:

- HTF 01: Fundamentals of Hydrogen and Safety
- HTS: Specialization and Application & Competence-Oriented Elective Courses
- HTM 01: Project Thesis including Project Seminar

4.2.1 Record of attendance for HTF 01 Fundamentals of Hydrogen and Safety

The record of attendance for this course is defined in the beginning of the semester by the lecturer. The announcement is published by the examination office.

4.2.2 Record of attendance for HTS: Specialization and Application & Competence-Oriented Elective Courses

The record of attendance for this course is defined in the beginning of the semester by the lecturer. The announcement is published by the examination office.

4.2.3 Record of attendance for Project Thesis with Project Seminar

Attendance is verified by a personal signature on the participation list.

The student has to attend all seminar presentations held in the class in which the project thesis was started.

5 Module catalogue

5.1 Compulsory Modules

5.1.1 HTF 01: Fundamentals of Hydrogen and Safety

Module Responsible	Prof. Dr.-Ing. Patrick Preuster
Lecturer	Prof. Dr.-Ing. Patrick Preuster, Prof. Dr.-Ing. Wolfgang Arlt
Module Group	Compulsory
Module Duration	1 semester
Term	Winter
Applicability of the module in the degree programmes	Mandatory subject in HYT-Master
Course Type	• Lecture: 80% • Exercise: 20% • Computer Course: 0% • Lab Course: 0%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Learning Goals	Basic and advanced understanding of Hydrogen, its properties and characteristics and the main aspects of the safe handling, storage and transport of Hydrogen
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
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

5.1.2 HTF 02: Scientific Methods and Writing

Module Responsible	Prof. Dr.-Ing. Johannes Völkl
Lecturer	vhb-Course
Module Group	Compulsory
Module Duration	1 semester
Term	Winter / Summer (starting summer term 2023)
Applicability of the module in the degree programmes	Mandatory subject in HYT-Master
Course Type	• Lecture: 80% • Exercise: 20% • Computer Course: • Lab Course:
Credit Points (ECTS)	5
Weekly Working Hours	
Total Workload	150 hours
Prerequisites	
Learning Goals	"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. 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. 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. Literature search 3. Literature management 4. Planning of the writing process THE WRITING PROCESS 5. Language and Expression 6. Methods 7. Introduction and Aims 8. Results 9. Discussion and Conclusion 10. Title and Abstract 11. Visuals 12. Bibliography and Citation PUBLISHING AND PRESENTING 13. Submission to the journal 14. Oral presentation 15. Poster presentation 16. Peer-reviewing
Material	
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

5.1.3 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 programmes	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 o Dealing with complex challenges o Making decisions based on academic and scientific principles, even under uncertainties o Acquiring new knowledge independently o 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	• Oral Examination: A seminar presentation of the project thesis in the course's project seminar is required. This examination consists of 20 minutes of presentation and 10 minutes of discussion. The examination is held during the lecture term. The seminar date is assigned by the student secretary in coordination with the supervisor. 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 must be handed in as a written scientific report. The submission deadline is defined with the application form for the project topic. The deadline should be within the semester term in which the project thesis was started. The report should be submitted in a digital format, such as a pdf-file.
Literature	

5.1.4 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 programmes	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 o Dealing with complex challenges o Making decisions based on academic and scientific principles, even under uncertainties o Acquiring new knowledge independently o Working independently on an extensive academic and scientific topic • Communication competencies o 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 seminar presentation of the project thesis within the course's project seminar. This examination consists of 20 minutes of presentation and 10 minutes of discussion. The examination is held during the lecture term. The seminar date is assigned by the dean of studies in coordination with the supervisor. Alternatively the presentation is given as part of an academic or technical conference if the examiner is present. • Written project thesis: The thesis is a written scientific report. The submission deadline is defined in the application form. The deadline is in the semester term in which the project thesis was started. The report is submitted in a digital format, such as a pdf-file.
Literature	

5.2 Module Group: Specialization and Application & Competence-Oriented

5.2.1 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 programmes	MF 38 Chemical H2 Conversion
Course Type	• Lecture: 50% • Exercise: 50% • Computer Course: 0% • Lab Course: 0%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Basic knowledge in Chemistry, Thermodynamics and (Process) Modeling
Learning Goals	Students acquire in-depth knowledge of Hydrogen conversion processes • Understanding the different routes for Hydrogen conversion based on desired products and the origin of hydrogen • Understanding the material cycle of the chemical industry and bringing this understanding into the context of new developments • Comparing different routes based on economic and sustainability quality parameters • Analyzing the different processes to get all reactants for the conversion processes around Hydrogen

	• Deepening the understanding of Hydrogen conversion processes by working on an individual case study of a selected example of a Hydrogen conversion process
Content	• Overview of Hydrogen conversion processes • Overview of the material cycle of the chemical industry • Overview of different sources for all important components of the material cycle • Introduction of economic and sustainability performance indicators • Comparison of different routes of hydrogen conversion processes • Individual case study on a selected example of a hydrogen conversion process
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

5.2.2 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 programmes	CI 134.2 Homogeneous catalysis; UT 34.2 Homogeneous catalysis
Course Type	• Lecture: 50% • Exercise: 0% • Computer Course: 0% • Lab Course: 50%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Profound knowledge in Chemistry
Learning Goals	• Overview and knowledge of the 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

5.2.3 HTS 03: Energy Politics and Laws

Module Responsible	Prof. Dr.-Ing. Johannes Völkl
Lecturer	NN
Module Group	Application & Competence-Oriented
Module Duration	1 semester
Term	Summer
Applicability of the module in the degree programmes	---Application and competence oriented elective course in HYT-Master
Course Type	• Lecture: 100% • Exercise: 0% • Computer Course: 0% • Lab Course: 0%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	None
Learning Goals	Basic understanding of Energy Politics and Laws with a special focus on Renewable Energy and Hydrogen Technology
Content	• Overview of Energy Politics • Overview of Energy Laws
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

5.2.4 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 programmes	---Specialization elective course in HYT-Master
Course Type	• Lecture: 75% • Exercise: 25% • Computer Course: 0% • Lab Course: 0%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Learning Goals	• Understanding the fundamentals in thermodynamic properties of Hydrogen • Analyzing different thermodynamic calculation methods, especially for Hydrogen • Understanding the fundamentals of Hydrogen combustion • Understanding the thermodynamic fundamentals of combustion engines for the production of electricity and heat or mobility applications
Content	• Overview of thermodynamic cycle processes • Property method for hydrogen • General combustion theory • Comparison of hydrogen combustion with hydrocarbon combustion • Thermodynamic fundamentals of Hydrogen compression

Material	Lecture notes as downloadable files (learning campus)
Module Responsible	Prof. Dr.-Ing. Johannes Völkl
Lecturer	tbd

5.2.5 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 programmes	---Specialization elective course in HYT-Master
Course Type	• Lecture: 75% • Exercise: 25% • Computer Course: 0% • Lab Course: 0%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Learning Goals	Students acquire in-depth knowledge of Hydrogen generation processes • Understanding the different routes for Hydrogen generation processes • Comparing conventional and sustainable process routes for the generation of hydrogen • Deepening the understanding of the differences in process routes and the specific challenges, advantages and disadvantages
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

5.2.6 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 programmes	---Specialization elective course in HYT-Master
Course Type	• Lecture: 50% • Exercise: % • Computer Course: 50% • Lab Course: %
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Learning Goals	Overview and knowledge of the requirements, challenges, and solutions for hydrogen storage and transportation in a carbon neutral economy. Knowledge, comparative analysis and application-oriented evaluation of technologies for the storage and transport of hydrogen.
Content	• Overview of Hydrogen storage methods • Overview of Hydrogen transport methods • Detailed discussion of selected storage methods • Detailed discussion of selected transport and distribution methods • Comparison of different methods to store and transport Hydrogen
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

5.2.7 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 programmes	---Specialization elective course in HYT-Master
Course Type	• Lecture: 75% • Exercise: 0% • Computer Course: 0% • Lab Course: 25%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Learning Goals	• Understanding the fundamentals of electrochemical process engineering and its applications • Comparing electrochemical and conventional processes Deepening the understanding of electrochemical reactor systems
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
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

5.2.8 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 programmes	MF 43 Techno-Economic Analysis and Simulation
Course Type	• Lecture: 50% • Exercise: 25% • Computer Course: 25% • Lab Course: 0%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering
Learning Goals	• Understanding how to carry out Techno-Economic Analysis • Comparing different process routes based on Techno-Economic criteria • Understanding how to obtain all required data • Deepening the understanding in the application of Simulation for process development and process evaluation
Content	• Fundamentals of economical process assessment: How to calculate CAPEX and OPEX and use those values to derive corresponding criteria • Comparison of different cost 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 • The theoretical background of the content of the module is applied in exercises and computer courses throughout the semester
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

5.2.9 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 programmes	
Course Type	• Lecture: 80% • Exercise: 20% • Computer Course: 0% • Lab Course: 0%
Credit Points (ECTS)	5
Weekly Working Hours	4
Total Workload	150 hours
Prerequisites	Fundamental understanding of (chemical) engineering

Learning Goals	• Basic terms of the energy industry • Impact of power generation on environment and climate • Being able to explain the functioning and areas of application of the various technologies for power and heat generation, distribution and storage technologies • Being able to demonstrate the links between energy generation and climate change • Being able to identify key factors in the pricing of electricity, gas and heat • Being able to make comparative assessments of the environmental impact of different technologies of energy generation • Carrying out simple material/energy flow calculations for energy generation plants • 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 • Natural gas and biogas production, storage, transport, distribution • Conventional district heating production and distribution
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