Appendix of the accreditation application for the course of studies Process Engineering and Energy Technology (PEET)

Module Manual

Table of Content

ANNOTATION AND MODULE OVERVIEW

Applicability of the modules:

The courses of studies at Bremerhaven University of Applied Sciences are stated in the row "courses of studies", in which the modules should be applied (distinguished between duty and choice).

Frequencs of the modules:

All modules are offered once a year. The section "offering frequency" will indicate whether they are offered in the summer semester or winter semester.

Length of a module:

Modules range over a maximum of 2 semesters. Normally a module is completed within a semester. Information about the length can be found in the section "frequency".

Note to the collegiate workload:

One Credit Point (CP) means a workload of 30 hours of work (including self study time). One semester consists of 14 classroom sessions. 60 minutes are estimated for one SWS.

Requirement for the assignment of Credit Points is to successfully complete the examinations referred in the section "examinations". Particulars are managed by the subject-specific examination regulation. Beside the provided modules, offers from Studium Generale or other modules from faculty 1 can be chosen. After an application, modules from faculty 2 can be attended, too.

Mode of examination:

The listed modes of examination within a module represent possible alternatives. The actually relevant examination mode is announced at the beginning of the semester.

Annotation and abbreviations:

CP:	Leistungspunkte (credit points) nach dem European Credit Transfer and Accumulation System (ECTS)
GF:	Gewichtungsfaktor zur Ermittlung der Modulnote, wenn das Modul mehrere Prüfungsleistungen enthält, (weighting factor for determination of the module grade, when module includes several modes of examinations)
h:	Stunde (1h = 60 Minuten), (1 hour = 60 minutes)
PL:	Prüfungsleistung (benotet), (examination; if passed, then with a grade)
SL:	Studienleistung (unbenotet), (credit achievement; if passed, then without grade)
SoSe:	Sommersemester, (summer term)
SWS:	Semesterwochenstunden, (weekly hours within teaching period of a term)
WiSe:	Wintersemester, (winter term)

Abbreviations in the credit achievements and examinations:

E:	Entwurf, (preliminaty concept / design)
H:	Hausarbeit, (term paper)
K:	schriftliche Arbeit unter Aufsicht (Klausur), (written exam)

M: Mündliche Prüfung, (oral exam)
MA: Masterarbeit und Kolloquium (master thesis and colloquium)
P: Projektarbeit, (project work)
R: schriftlich ausgearbeitetes Referat, (written presentation)
V: Praktischer Versuch, (practical lab experiment)
/: alternative Prüfungsleistung, (alternative modes of examination)

Module overview

Semester M1 (30 CP)	Semester M2 (30 CP)	Semester M3 (30 CP)
Fundamentals of Simulation SI-FOS (5 CP)	Electrochemical Processes SC-ECP (5 CP)	Master Thesis and Colloquium MA-PEET
Provision of Material Properties SI-PMP (5 CP)	Students in Science SC-SIS (5 CP)	
Simulation of Process Plants SI-SPP (5 CP)	Science Topics SC-STO (5 CP)	
Advanced Energy Conversion EN-AEC (5 CP)	Thermal Unit Operations PE-TUO (5 CP)	
Solar and Wind Energy EN-SUW (5 CP)	Environmental Protection Technologies PE-ENP (5 CP)	
Energy from Biomass EN-BIO (5 CP)	Chemical Process Engineering PE-CRE (5 CP)	

Module groups

Simulation	Process Engineering and Environmental Technologies
Energy Technology	Science and Research

SIMULATION

Module Name	**C.1.** Fundamentals of Simulation						Abbreviation	SI-FOS
Module Group	Simulation						mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]				Bachelor / Master [ ]	
Summer / Winter	Summer term	Duration	1 Semester				Semester Term	1
Bachelor / Master program	PEET							
Teaching Staff	Stell, Lompe						Person in Charge	Schütz
Courses	Course Types		Contact hours (SWS)	SL	PL	GF	Group size	Module examination
	Lecture: Numerical Analysis		1	[ ]	K / M / V	0.5	150	[X]
	Laboratory: Numerical Analysis		1	[ ]			15	
	Laboratory: Simulation of Process Control		2	[ ]			15	
Learning Outcomes	Students know the foundations and limits of numerical solution methods for systems of differential equations that describe the technical procedures. So that they can simulate such processes in the computer. They are able to apply these principles to simple examples. They know criteria for applicability of numerical methods. They know a application of numerical methods in the context of process control. They are able to regulate industrial processes and application software to simulate both the control and the processes.							
Content	In "Numerical Analysis", the computer access to higher mathematics is taught. On the example of the computer language SciLab algorithms of numerical analysis are developed and compared. A central concept is the machine accuracy of the numerical representation (mantissa). As a basic method of numerical analysis, the discretization of physical model and equations is introduced and deepened in different contexts (interpolation, integration, time step method, partial differential equations). The solution methods for systems of nonlinear equations lead to optimization methods for concrete numerical problems of engineering, including non-linear constraints. In "Simulation of process control" on the basis of industrial process control system PCS7 a previously constructed laboratory process is regulated and this scheme is simulated in various ways. This includes: - Establish a process on a laboratory scale - Definition of input and output signals - Definition of the rule targets - Implementing the scheme with the process control system including visualization with different control parameters.							

	- Simulation of the input signals - Simulation of the automation system - Simulation of the process in the Process Control System - A review of the respective results						
Learning Methods	Lecture, Computer Internships, Laboratory						
Literature	Numerical Analysis, Francis Scheid, Schaum's Outlines, McGraw-Hill, ISBN 0070552215, Dokumentation und Tutorial des PCS7-Systems						
Examinations	Lecture: Written examn (2h) or oral examn Lab: Practical lab experiments and complementary project work						
Empowerment to participate with regards to	formal	Knowledge in Linear Algebra					
	content	Fundamentals Control Engineering					
Workload [150h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship	
	14	0	42	0	94		
Language	English						
Remarks							
Credits	5			Module counts to final score		[X]	

Module Name	**C.2.** Provision of Material Properties			Abbreviation	SI-PMP
Module Group	Simulation			mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]	Bachelor/Master [ ]	
Summer/Winter	Summer term	Duration	1 Semester	Semester Term	2
Bachelor/Master program	PEET				
Teaching Staff	Schütz			Person in Charge	Schütz

Courses	Course Types	Contact Hours (SWS)	SL	PL	GF	Group size	Module Examination
	Lecture: calculation of material properties	2	[ ]	K/V/M	0.5	150	[X]
	Lab/Seminar: Measurement of material properties	2	[ ]		0.5	15	

Learning Outcomes	Upon successful completion, students are able to: - know the essential material properties of fluid systems and their dimensions - perform and to assess mathematical methods for approximation of functions of measurements - assess accuracy and display areas - know mixing rules and to question critical their application - develop their own methods of measurement and subsequent analysis of unknown materials data
Contents	In subsequent courses the following contents can be considered known - though not in all details conveyed: - Thermal state equations and their evaluation - Caloric equations of state, heat capacity - Transport coefficients (viscosity, diffusion coefficient, thermal conductivity ....) - Mixing rules (linear, mixing parameters) - GE models for vapor-liquid-equilibria - activity coefficients - Diagrammatic representations (triangle diagram, Jaenicke diagram McCabe-Thiele diagram, etc. ...)
Learning Methods	Lecture for calculation of baseline data, Laboratory Internship for measurement of baseline data
Literature	Reid/Prausnitz/Poling: The Properties of Gases and Liquids, McGraw-Hill, ISBN 0-07-051799-1
Examinations	Lecture: Written examn (3.5h) or oral examn; Lab/Seminar: practical lab experiments with protocols and oral examn (presentation)
	formal: none

Prerequisites for attending		content	none			
Workload [150h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship
	28	0	28	42	52	0
Language		English				
Credits		5		Module counts to final score		[X]

Module Name	**C.3.** Simulation of Process Plants						Abbreviation	SI-SPP
Module Group	Simulation						mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]				Bachelor/Master [ ]	
Summer/Winter	Summer term	Duration	1 Semester				Semester Term	1
Bachelor/Master program	PEET							
Teaching Staff	Stell						Person in Charge	Schütz
Courses	Course Types	Contact Hours (SWS)	SL	PL	GF	Group size	Module Examination	
	Lecture	1	[ ]	K/V/M	1.0	150	[X]	
	Laboratory	2	[ ]			15		
Learning Outcomes	In this module, the basic approach is illustrated in the simulation of industrial processes. Particular importance is attached to the property calculation using simulation software. Furthermore, the process of synthesis, optimization of processes, the dimensioning of system components, capital cost and operating cost of a plant and the dynamic simulation of chemical engineering processes are treated.							
Contents	1. Introduction to Process Simulation 2. Fundamentals of steady flow process 3. Introduction to simulation software AspenTech 4. Property calculation using AspenTech Properties 5. Process development using AspenTech HYSYS 6. Dimensioning and costing 7. Dynamic simulation of chemical engineering processes							
Learning Methods	Theoretical lectures, development of technical processes using simulation software AspenTech							
Literature	Integrated Design and Simulation of Chemical Processes, Alexandre C. Dimian (ISBN 0-444-82996-2 and Process Design Principles, Seider, Seader, Lewin (ISBN 0-471-24312-4)							
Examinations	Lecture: Written examn (software concept) or oral examn; Lab: practical experiments (in silico)							
Prerequisites for attending	formal	none						
	content	none						
Workload [150h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship		
	14		28	14	94			
Language	English							
Remarks								
Credits	5			Module counts to final score		[X]		

ENERGY TECHNOLOGY

Module name	**C.4.** Advanced Energy Conversion						Abbreviation	EN-AEC
Module group	Energy Technology						mandatory [X]	optional [X]
Level	Bachelor [ ]		Master [X]				Bachelor/Master [ ]	
Summer/Winter	Summer term	Duration	1 Semester				Semester	1
Bachelor/Master program	PEET							
Teaching staff	Gottschalk						modulverantw.	Gottschalk
Courses	Course Types	Contact Hours (SWS)	SL	PL	GF	Group size	Module Examination	
	Seminar	4	[ ]	R/M	1.0	150	[X]	
Learning outcomes	Acquisition of skills in design, calculation and application of energy conversion processes for electricity and/or heat, with high efficiencies to achieve a better use of primary or renewable energy sources. This is consistent with the context and a reduction of the impact of the greenhouse effect (less CO_2 production). The potential to achieve more efficient use of energy is discussed using various technologies and in different conditions. Considering the two main secondary energies, electricity and heat, and their usage, extensive knowledge for decision makers in this area is mediated.							
Content	Simple thermal energy cycles, cogeneration, combined processes, heat pumps, fuel cells, etc.							
Learning methods	Seminar, preparation, postprocessing, workshop							
Literature	M.C. Potter and C.W. Samerton; Richard A. Zaboransky; Mostofizadeh; Klaus Manny; Karl Strauß							
Prüfungsformen	Written report and oral examn (presentation and dicsussion)							
Prerequisites for attending	formal	none						
	content	none						
Workload [150] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship		
		56		56	38			
Language	English							
Remarks								
Credits	5			Module counts to final score		[X]		

Module Name	**C.5.** Solar and Wind Energy						Abbreviation	EN-SUW
Module Group	Science and Research						mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]				Bachelor/Master [ ]	
Summer/Winter	Summer term	Duration	1 Semester				Semester Term	1
Bachelor/Master program	PEET							
Teaching Staff	Fichter, Theis-Bröhl						Person in Charge	Theis-Bröhl

Courses	Course Types	Contact hours (SWS)	SL	PL	GF	Group size	Module examination
	Lecture Fundamentals of Solar Energy	2	[ ]	K/M	0.5	150	[X]
	Lecture Wind Energy	2	[ ]		0.5	150	

Learning Outcomes	The module aims to obtain knowledge about solar and wind energy use, design and calculation of components on the basis of solar and wind energy. Possibilities and limits of the use of renewable energy and conditions for the use as the geographic location, environmental conditions, seasonal fluctuations and intensity of the energy should be discussed. Students should be able to construct and to operate components for renewable energy.
Content	Basic physical knowledge about solar energy, opportunities and limitations of converting of solar and wind energy into electricity.
Learning Methods	Lecture, preparation, postprocessing
Literature	M.C. Potter and C. W. Samerton; Richard A. Zaboransky; Mostofizadeh; Klaus Manny; Karl Strauß; V. Quaschning: Regenerative Energiesysteme; K. Mertens: Photovoltaik
Examinations	Written examn (2.5h) or oral examn
Empowerment to participate with regards to	formal: none content: none

Workload [150h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Post processing	Internship
	56		0	0	94	

Language	English		
Remarks			
Credits	5	Module counts to final score	[X]

Module Name	**C.6.** Energy from Biomass						Abbreviation	EN-BIO
Module Group	Energy Technology						mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]				Bachelor/Master [ ]	
Summer/Winter	Summer term	Duration	1 Semester				Semester Term	1
Bachelor/Master program	PEET							
Teaching Staff	Lompe, Schütz						Person in Charge	Lompe

Courses	Course Types	Contact Hours (SWS)	SL	PL	GF	Group size	Module Examination
	Lecture	2	[ ]	K/M	1.0	150	[X]
	Laboratory	2	V/M			15	

Learning Outcomes	Students have an overview of different kinds of biomass and their availability as well as economic and social interactions between agricultural production for food and energy. They know the range of processes for energetic biomass conversion. Students are familiar with scientific basics, process unit operations, and design of plants for biological processes like biogas, bio methane, bio ethanol, and bio diesel. They know fundamental processes of thermo-chemical biomass conversion like pyrolysis, gasification, and incineration.
Content	- Biomass potential from agriculture and from wastes - Interaction between food production and energy conversion - process overview - biochemical and kinetic fundamentals of biological conversions - Biogas and bio methane production - Production of bio ethanol - Bio diesel production - Pyrolysis, gasification and incineration processes - Production of synthetic fuel
Learning Methods	Lecture, laboratory training
Literature	Energy from biomass
Examinations	Written examn (1.5h) or oral examn
Prerequisites for attending	formal: none content: none

Workload [150h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship
	28	0	28	28	66	

Language	English
Remarks	

Credits	5	Module counts to final score	[X]

SCIENCE AND RESEARCH

Module Name	**C.7.** Electrochemical Processes						Abbreviation	SC-ECP
Module Group	Electrochemical Processes						mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]				Bachelor/Master [ ]	
Summer/Winter	Winter term	Duration	1 Semester				Semester Term	2
Bachelor/Master program	PEET							
Teaching Staff	Berger						Person in Charge	Berger
Courses	Course Types		Contact Hours (SWS)	SL	PL	GF	Group size	Module Examination
	Lecture		2	[ ]	K/M	1.0	150	[X]
	Laboratory		2	V/M		0.0	15	
Learning Outcomes	The students are able to understand, calculate, detect and evaluate electrochemical methods and processes.							
Contents	Fundamentals: Equilibrium electrochemistry, electrode kinetics, electrochemical cells, measurement methods. Applications: potentiometry (pH measurement), Conductometry, fuel cells, batteries and accumulators, Corrosion and Corrosion Control (upgradeable), measurement methods							
Learning Methods	Seminar, demonstration experiments, calculation exercises, use of the Internet as an information source, laboratory							
Literature	(1a) Atkin's Physical Chemistry / P.W. Atkins, J. De Paula; Oxford UP, 2002, (7th ed.); and: Student's solutions manual for Atkin's physical chemistry; Oxford Univ. Press, any edition; (1b) Physikalische Chemie / Peter W. Atkins; Weinheim [u.a.] : Wiley-VCH, jede Ausgabe; (2a) Electrochemistry / Carl H. Hamann; Andrew Hamnett; Wolf Viel-stich; Weinheim [u.a.]: Wiley-VCH, any edition; (2b) Elektrochemie / Carl H. Hamann; Wolf Vielstich; Weinheim [u.a.] : Wiley-VCH, each edition.							
Examinations	Written examn (2h) or oral examn							
Prerequisites for attending	formal	B. Eng, B. Sci. Process engineering, chemical engineering inter alia						
	content	4 SWS chemistry, 4 SWS Thermodynamics, 4 SWS materials engineering, physics basics or electrical engineering basics						

Workload [150h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship
	28	0	28	28	66	0
Language		English				
Remarks						
Credits		5		Module counts to final score		[X]

Module Name	**C.8.** Students in Science						Abbreviation	SC-SIS
Module Group	Rsearch Study						mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]				Bachelor/Master [ ]	
Summer/Winter	Winter term	Duration	2 Semester				Semester Term	2
Bachelor/Master program	PEET							
Teaching Staff	Schütz, John, Gottschalk, Lompe						Person in Charge	Schütz
Courses	Course Types		Contact Hours (SWS)	SL	PL	GF	Group size	Module Examination
	Research seminar		2	[ ]	M/R	0.5	150	[X]
	laboratory work MVT		0.33	[ ]		0.5	15	
	laboratory work TVT		0.33				15	
	laboratory work VET		0.33				15	
Learning Outcomes	The aim of the module is the integration of students into the current research processes of Bremerhaven University of Applied Sciences and the cooperating industrial companies. Through active participation in the accompanying research the difference in presentation between the art and focused research are clarified. Mechanisms of typical university research and the elements of cooperative innovation and interdisciplinary projects are made available. Research interested students are encouraged to include other activities of independent research. Promotion interested students get the opportunity to communicate with research partners.							
Contents	The contents are based on current projects at Bremerhaven University of Applied Sciences or based on the interests of cooperative partners.							
Learning Methods	Seminaristic teaching method, project meetings and presentations							
Literature	As per the current projects							
Examinations	Oral examn (presentation plus discussion) and written report							
Prerequisites for attending	formal	none						
	content	none						
Workload [150h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship		
	0	28	14	66	28	14		
Language	English							
Remarks								
Credits	5			Module counts to final score		[X]		

Module Name	**C.9.** Science Topics				Abbreviation	SC-STO
Module Group	Current scientific topics				mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]		Bachelor/Master [ ]	
Summer/Winter	Winter term	Duration	1 Semester		Semester Term	2
Bachelor/Master program	PEET					
Teaching Staff	Theis-Bröhl, Klobes				Person in Charge	Klobes

Courses	Course Types	Contact hours (SWS)	SL	PL	GF	Group size	Module examination
	Lecture Nanotechnology	2	[ ]	K/M/R/V	0.5	150	[X]
	Laboratory Nanotechnology	2	[ ]		0.5	15	

Learning Outcomes	The module aims to give an overview over modern technology, which is important for many fields in industry. Students should know about the physical and technological basics of this technology. They should be familiar with production techniques and properties and they should be introduced into analytical measuring techniques. Finally, students also know about risks and danger for people and environment. The students should be able: - To orient themselves with the help of the lecturer in unknown scientific fields - They know about basic physical relations - They are able to apply specific preparative and measuring techniques and to analyze the results on a scientific level - To be critical with the matter studied by evaluating risks which are connected to the specific technology
Content	As a modern technology, nanotechnology is chosen from 2010 ff. - Overview over and introduction into different subareas - Physical basics of nanotechnology (physics at the nano scale) - Preparation and properties of nanostructures - Risks connected to nanotechnology
Learning Methods	Lecture, seminar, project work, presentation, colloquium, laboratory, excursion report, preparation, post processing,
Literature	Wolf: Nanophysics and Nanotechnology; Rubahn, Horst-Günter: Basics of Nanotechnology; Hartman: Nanotechnologie, Shong, Haur, Wee: Science at the Nanoscale: An Introductory Textbook
Examinations	Lecture: written examn (2h) or oral examn; Lab: practical experiments and lab report

Empowerment to participate with regards to		
	formal	none
	content	none

Workload [150h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship
	28		28		94	
Language		English				
Remarks						
Credits		5		Module counts to final score		[X]

PROCESS ENGINEERING AND ENVIRONMENTAL TECHNOLOGIES

Module Name	**C.10.** Thermal Unit Operations						Abbreviation	PE-TUO
Module Group	Process Engineering and Environmental Protection						mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]				Bachelor/Master [ ]	
Summer/Winter	Winter term	Duration	2 Semester				Semester	2
Bachelor/Master program	PEET, Wind energy							
Teaching staff	Schütz, Slatosch						Person in charge	Schütz
Courses	Course Types		Contact Hours (SWS)	SL	PL	GF	Group size	Module Examination
	Lecture: Advanced thermal processes		2	[ ]	K/M	1.0	150	[X]
	Laboratory: Advanced thermal processes		2	V/M		0.0	15	
Learning outcomes	Design and calculation of thermal units in evaporation, rectification, absorption and extraction. The focus is on the optimization of energy consumption and material flow. The various processes are also considered in terms of their requirements, e.g. production properties. Graduates of the course have competencies in the calculation and design of multistage and combined operations. The analysis process will take place on the basis of computer programs.							
Content	Selected topics from the fields of evaporation, crystallization, sublimation, drying, distillation, rectification, absorption, adsorption, extraction. Unlike the Bachelor course, the focus here is on the development of methods (in contrast to the methods of control) - the students should not comprehend default calculations, but develop new computational methods							
Learning methods	lecture, laboratory and internship, simulations							
Literature	Perry and Chilton; Philip A. Schweitzer; Warren L. McCabe; Mostofizadeh; Jimmy L. Humphry; Schlünder; Sattler							
Examinations	Written examn (2h) or oral examn							
Prerequisites for attending	formal	none						
	content	none						
Workload [150] (1CP=30h)	Vorlesung	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship		
	28		28	42	52			
Language	English							

Remarks			
Credits	5	Module counts to final score	[X]

Module Name	**C.11.** Environmental Protection Technologies				Abbreviation	PE-ENP
Module Group	Process Engineering and Environmental Protection				mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]		Bachelor/Master [ ]	
Summer/Winter	Winter term	Duration	1 Semester		Semester Term	2
Bachelor/Master program	PEET					
Teaching Staff	John, Lompe				Person in Charge	John

Courses	Course Types	Contact hours (SWS)	SL	PL	GF	Group size	Module Examination
	Lecture: Special aspects of environm. technologies	2	[ ]	K/M/H	0.5	150	[X]
	Lecture: Sea water desalination	2	[ ]		0.5	150	

Learning Outcomes	Special aspects of environmental technologies: Students are able to design environmental processes on the basis of scientific methods and basic knowledge. They know how to apply theoretical fundamentals and results from literature or own experiments on design and operation of processes and plants. They are familiar with methods for data analysis and critical discussion of results. Sea water desalination: Students know the most relevant processes of sea water desalination They are familiar with fundamentals of reverse osmosis and thermal processes and are able to use that knowledge for the design of such processes.
Content	Special aspects of environmental technologies: A selection from the following processes or similar processes are explained and discussed: - Biological nitrogen elimination from waste water or process water - Water reuse - Biological phosphorus elimination - Recycling of nutrients - Downstream processing of residues from biogas plants - Conversion of biogas to biomethane - Optimization of biogas plants - Recycling of solid wastes - thermal sewage sluge treatment - solare sewage sludge drying Sea water desalination: - Properties of sea water - Fundamentals of thermal desalination processes

		- Fundamentals of reverse osmosis - Design of desalination plants - Pre- and post-treatment of water - Energy reuse - Use of solar or wind energy for desalination Environmental aspects of sea water desalination					
Learning Methods		Lecture, examples					
Literature		An Engineer's Guide to Desalination					
Examinations		Written examn (3h) or oral examn or term paper					
Prerequisites for attending		formal	none				
		content	none				
Workload [150h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship	
	56	0	0	28	66		
Language		English					
Remarks							
Credits		5		Module counts to final score			[X]

Module Name	**C.12.** Chemical Process Engineering				Abbreviation	PE-CRE
Module Group	Environmental and Process Technology				mandatory [X]	optional [ ]
Level	Bachelor [ ]		Master [X]		Bachelor/Master [ ]	
Summer/Winter	Winter term	Duration	1 Semester		Semester Term	2
Bachelor/Master program	PEET					
Teaching Staff	Schütz,				Person in Charge	Schütz

Courses	Course Types	Contact Hours (SWS)	SL	PL	GF	Group size	Module Examination
	Lecture: Gasification and Chemical Reactions	2	[ ]	K/M/E	0.5	150	[X]
	Laboratory: Modeling of gasification reactions	2	[ ]		0.5	15	

Learning Outcomes	Upon successful completion of the course the students are able to evaluate energy-related processes with chemical reactions, to choose correct solutions and accurately assess the potential in the chemical conversion. In the lecture "Chemical Reaction Engineering and Gasification" the fundamentals of chemical reaction engineering and chemical process will be taught and then deepened on the example of thermal gasification of wood, coal and waste and the biological gasification of biomass.
Contents	The following course content - though not treated in detail - are assumed to be known, related to chemical reaction engineering and gasification: Basics · nomenclature · balance sheet, key reactions and key components · Chemical thermodynamics and law of mass action homogeneous reactions · types of reactors (batch, plug-flow, CSTR) · cascade, short circuit, circulation reactor and combinations heterogeneous reactions · conceptual models (catalyzed and non-catalyzed reactions) · reactors for heterogeneous reactions gasification processes · thermal gasification · biological gasification
Learning Methods	Seminaristic lecture, computer laboratory
Literature	As an example: Skogestad: Chemical and Energy Process Engineering, CRC Press, ISBN 978-1-4200-8755-0
Examinations	Lecture: Written examn (3h) or oral examn; Lab: concept/design (computer program)
Prerequisites for attending	Formal: - none - Content: satisfactory knowledge in basic chemistry

Workload [150h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship
	28		28	28	66	
Language		English				
Remarks						
Credits		5		Module counts to final score		[X]

FINAL EXAMINATION

Module Name	**C.13.** Final Examination							Abbreviation	MA-PEET
Module Group	Completion Procedure							mandatory [X]	optional [ ]
Level	Bachelor [ ]			Master [X]				Bachelor/Master [ ]	
Summer/Winter	Summer term	Duration		1 Semester				Semester Term	3
Bachelor/Master program	PEET								
Teaching Staff	All academic teaching staff							Person in Charge	Theis-Bröhl
Courses	Course Types			Contact Hours (SWS)	SL	PL	GF	Group size	Module Examination
	Master Thesis			0	[ ]	MA	0.7	150	[X]
	Colloquium			2	[ ]		0.3		
Learning Outcomes	In the final procedure, the students demonstrate that they are capable of: · creating an independent development and methodical examination of an engineering topic (Master Thesis) on a scientific basis within a processing time of 22 weeks, · giving a public university lecture on the topic of the Master Thesis with a duration of 30 minutes and a discussion afterwards.								
Contents	Content of the colloquium: topic of the Master Thesis plus the contentual closely related subjects of the work.								
Learning Methods	Separate written academic work; colloquium with a public university and non-public university time percentage.								
Literature	As an example: Skogestad: Chemical and Energy Process Engineering, CRC Press, ISBN 978-1-4200-8755-0								
Examinations	Master Thesis and Colloquium								
Prerequisites for attending	formal	45 ECTS credit points awarded for passed modules according to the PEET curriculum							
	content	none							
Workload [900h] (1CP=30h)	Class	Exercises, seminars, others	Laboratory	Home work/presentation	Preparation/ Postprocessing	Internship			
	0	28	0	872	0	0			
Language	English or German								
Remarks									
Credits	30			Module counts to final score	[X]				