Karlsruher Institut für Technologie

Module Handbook
Chemical and Process Engineering Master 2016
(Master of Science (M.Sc.))

SPO 2016

Summer term 2020

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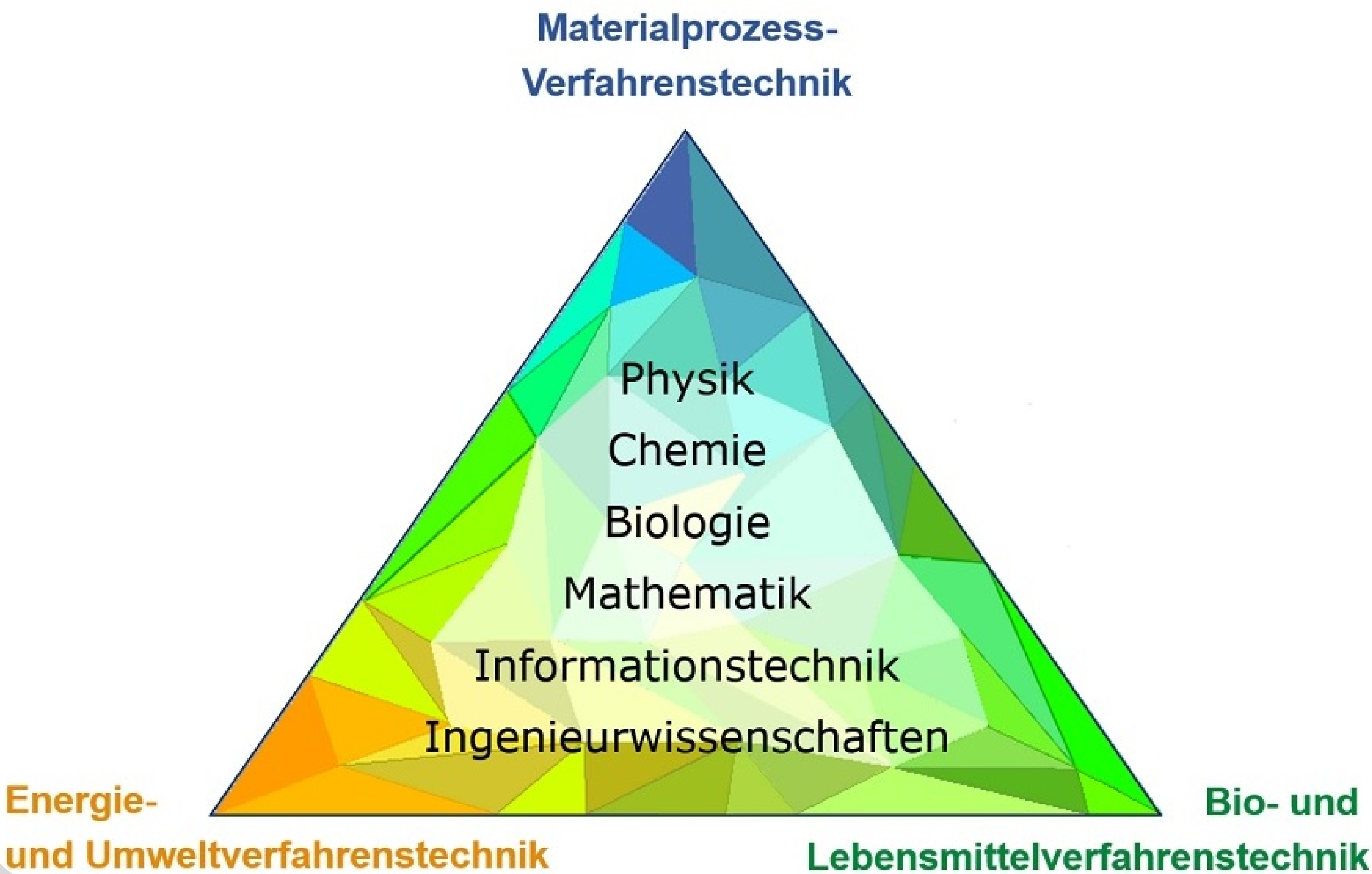
KIT DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING



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1 Field of study structure

Mandatory	
Master Thesis	30 CR
Advanced Fundamentals	32 CR
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1.1 Master Thesis

Credits
30

Mandatory		
M-CIWVT-104526	Module Master Thesis	30 CR

1.2 Advanced Fundamentals

Credits
32

Mandatory		
M-CIWVT-104374	Process Technology	8 CR
Election block: CIW (at least 3 items)		
M-CIWVT-103058	Thermodynamics III	6 CR
M-CIWVT-103064	Selected Formulation Technologies	6 CR
M-CIWVT-103072	Computational Fluid Dynamics	6 CR
M-CIWVT-104377	Thermal Transport Processes	6 CR
M-CIWVT-104378	Particle Technology	6 CR
M-CIWVT-104383	Kinetics and Catalysis	6 CR
M-CHEMBIO-104486	Physical Chemistry (incl. Lab)	6 CR
Election block: BIW (at most 1 item)		
M-CIWVT-103065	Biopharmaceutical Purification Processes	6 CR
M-CIWVT-104384	Biotechnological Production	6 CR
M-CIWVT-104386	Integrated Bioprocesses	6 CR

1.3 Technical Supplement Course

Credits
10

Election regulations
Elections in this field require confirmation.

Election block: Technical Supplement Course (at least 10 credits)		
M-CIWVT-103051	Heat Transfer II	6 CR
M-CIWVT-103058	Thermodynamics III	6 CR
M-CIWVT-103059	Statistical Thermodynamics	6 CR
M-CIWVT-103063	Thermodynamics of Interfaces	4 CR
M-CIWVT-103064	Selected Formulation Technologies	6 CR
M-CIWVT-103065	Biopharmaceutical Purification Processes	6 CR
M-CIWVT-103066	Process Modeling in Downstream Processing	4 CR
M-CIWVT-103068	Physical Foundations of Cryogenics	6 CR
M-CIWVT-103069	Combustion Technology	6 CR
M-CIWVT-103072	Computational Fluid Dynamics	6 CR
M-CIWVT-103073	Processing of Nanostructured Particles	6 CR
M-CIWVT-103074	Theory of Turbulent Flows without and with Superimposed Combustion	4 CR
M-CIWVT-103075	High Temperature Process Engineering	6 CR
M-CIWVT-103407	Water Technology	6 CR
M-CIWVT-103441	Biofilm Systems	4 CR
M-CIWVT-104255	Nutritional Consequences of Food Processing	4 CR
M-CIWVT-104263	Food Science and Functionality	4 CR
M-CIWVT-104266	Formulation of (Bio)pharmaceutical Therapeutics	4 CR
M-CIWVT-104268	Bioelectrochemistry and Biosensors	4 CR
M-CIWVT-104272	Biomimetic Interfaces and Bioconjugation	4 CR
M-CIWVT-104273	Commercial Biotechnology	4 CR
M-CIWVT-104274	Industrial Genetics	6 CR
M-CIWVT-104275	Industrial Biocatalysis	6 CR
M-CIWVT-104277	Multiphase Reaction Engineering	10 CR
M-CIWVT-104280	Heterogeneous Catalysis II	6 CR
M-CIWVT-104281	Chemical Process Engineering II	4 CR
M-CIWVT-104283	Reaction Kinetics	6 CR
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	6 CR
M-CIWVT-104286	Design of Micro Reactors	6 CR
M-CIWVT-104287	Catalytic Processes in Gas Technologies	4 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104289	Fuel Technology	6 CR
M-CIWVT-104290	Technical Systems for Thermal Waste Treatment	4 CR
M-CIWVT-104291	Refinery Technology - Liquid Fuels	6 CR
M-CIWVT-104292	Fluidized Bed Technology	4 CR
M-CIWVT-104293	Energy Technology	4 CR
M-CIWVT-104294	Flow and Combustion Instabilities in Technical Burner Systems	4 CR
M-CIWVT-104295	Combustion and Environment	4 CR
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	4 CR
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR
M-CIWVT-104299	Applied Combustion Technology	6 CR
M-CIWVT-105206	Design of a Jet Engine Combustion Chamber *First usage possible from 10/1/2019.*	6 CR
M-CIWVT-104301	Water Quality Assessment	6 CR

M-CIWVT-104302	Structure and Reaction of Aquatic Humic Substances	2 CR
M-CIWVT-104319	Microbiology for Engineers	4 CR
M-CIWVT-104320	Environmental Biotechnology	4 CR
M-CIWVT-104321	Practical Course Combustion Technology	4 CR
M-CIWVT-104322	Fluid Mechanics of Non Newtonian Fluids	8 CR
M-CIWVT-104326	Rheology and Rheometry	4 CR
M-CIWVT-104327	Dimensional Analysis of Fluid Mechanic Problems	4 CR
M-CIWVT-104328	Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids	4 CR
M-CIWVT-104329	Rheology of Polymers	4 CR
M-CIWVT-104330	Stability of Disperse Systems	4 CR
M-CIWVT-104331	Rheology of Complex Fluids and Advanced Rheometry	4 CR
M-CIWVT-104335	Rheology and Processing of Polymers	8 CR
M-CIWVT-104336	Rheology and Processing of Disperse Systems	8 CR
M-CIWVT-104337	Gas Particle Measurement Technology	6 CR
M-CIWVT-104338	Fundamentals of Motoric Exhaust Aftertreatment	4 CR
M-CIWVT-104339	Nanoparticles – Structure and Function	6 CR
M-CIWVT-104340	Gas Particle Separation Processes	6 CR
M-CIWVT-104342	Solid Liquid Separation	8 CR
M-CIWVT-104345	Data Analysis and Statistics	4 CR
M-CIWVT-104347	Bioprocess Development	4 CR
M-CIWVT-104350	Microfluidics	4 CR
M-CIWVT-104351	Process Instruments and Machinery and their Process Integration	4 CR
M-CIWVT-104352	Process and Plant Safety	4 CR
M-CIWVT-104353	Materials for Electrochemical Storage	4 CR
M-CIWVT-104354	Refrigeration B - Foundations of Industrial Gas Processing	6 CR
M-CIWVT-104356	Cryogenic Engineering	6 CR
M-CIWVT-104360	Thermodynamics of Phase Equilibria	6 CR
M-CIWVT-104361	Applied Molecular Thermodynamics	6 CR
M-CIWVT-104362	Supercritical Fluid Technology	6 CR
M-CIWVT-104363	Thermo- and Particle Dynamics of Particular Systems	6 CR
M-CIWVT-104364	Industrial Crystallization	6 CR
M-CIWVT-104365	Thermal Separation Processes II	6 CR
M-CIWVT-104368	Solar Process Technology	6 CR
M-CIWVT-104369	Mass Transfer II	6 CR
M-CIWVT-104370	Drying Technology	6 CR
M-CIWVT-104371	Heat Exchangers	4 CR
M-CIWVT-104374	Process Technology	8 CR
M-CIWVT-104377	Thermal Transport Processes	6 CR
M-CIWVT-104378	Particle Technology	6 CR
M-CIWVT-104383	Kinetics and Catalysis	6 CR
M-CIWVT-104384	Biotechnological Production	6 CR
M-CIWVT-104386	Integrated Bioprocesses	6 CR
M-CIWVT-104387	Modern Analysis Techniques for Process Optimization	2 CR
M-CIWVT-104388	Development of an Innovative Food Product	6 CR
M-CIWVT-104390	Economic Evaluation of Capital Projects	2 CR
M-CIWVT-104391	Rheology of Disperse Systems	2 CR
M-CIWVT-104395	Microrheology and High Frequency Rheology	2 CR
M-CIWVT-104396	Product Design II	4 CR
M-CIWVT-104397	Innovation Management for Products & Processes in the Chemical Industry	4 CR
M-CIWVT-104401	NMR for Engineers	6 CR
M-CIWVT-104402	Formulation Processes for Life Sciences	4 CR

M-CIWVT-104420	Unit Operations and Process Chains for Food of Plant Origin	6 CR
M-CIWVT-104421	Unit Operations and Process Chains for Food of Animal Origin	4 CR
M-CIWVT-104422	Processes and Process Chains for Renewable Resources	6 CR
M-CIWVT-104450	Measurement Techniques in Chemical Processing (including practical course)	6 CR
M-CIWVT-104451	Catalytic Micro Reactors	4 CR
M-CIWVT-104452	Surface Effects in Process Engineering	4 CR
M-CIWVT-104453	Energy and Environment	8 CR
M-CIWVT-104461	Chem-Plant	4 CR
M-MACH-100489	BioMEMS - Microsystems Technologies for Life Sciences and Medicine I	4 CR
M-MACH-100490	BioMEMS - Microsystems Technologies for Life Sciences and Medicine II	4 CR
M-MACH-100491	BioMEMS - Microsystems Technologies for Life Sciences and Medicine III	4 CR
M-MACH-102718	Product Development - Methods of Product Development	6 CR
M-CHEMBIO-104486	Physical Chemistry (incl. Lab)	6 CR
M-CIWVT-104478	Vacuum Technology	6 CR
M-CIWVT-104489	Sol-Gel Processes	4 CR
M-CIWVT-104490	Measurement Techniques in Chemical Processing	4 CR
M-CIWVT-104491	Catalytic Micro Reactors (including practical course)	6 CR
M-CIWVT-104560	Instrumental Analysis	4 CR
M-CIWVT-104570	Biobased Plastics	4 CR
M-MATH-102932	Numerical Methods in Fluid Mechanics	4 CR
M-MATH-102938	Project Centered Software-Lab	4 CR
M-MACH-102702	Organ Support Systems	4 CR
M-MACH-102720	Principles of Medicine for Engineers	4 CR
M-CHEMBIO-104620	Food Chemistry Basics	4 CR
M-CIWVT-104257	Practical Course in Food Process Engineering *First usage possible from 10/1/2019.*	2 CR
M-CIWVT-104886	Principles of Ceramic and Powder Metallurgy Processing	4 CR
M-BGU-104917	Wastewater Treatment Technologies *First usage possible from 4/1/2019.*	6 CR
M-CIWVT-103440	Practical Course in Water Technology	4 CR
M-CIWVT-104398	Fungal Biotechnology	6 CR
M-CIWVT-104399	Biotechnology in Bioeconomy	6 CR
M-CIWVT-104973	Digitization in particle technology	4 CR
M-CIWVT-105200	Liquid Transportation Fuels	6 CR
M-CIWVT-105210	Technology-Driven Business Start-up – Information for prospective Founders and Interesting Success Stories	4 CR
M-CIWVT-105205	Microfluidics and Case Studies	6 CR
M-CIWVT-105295	Biotechnological Use of Renewable Resources	4 CR
M-CIWVT-105202	High Temperature Process Engineering *First usage possible from 4/1/2020.*	4 CR
M-CIWVT-105380	Membrane Technologies in Water Treatment *First usage possible from 4/1/2020.*	6 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from 4/1/2020.*	6 CR
M-CIWVT-105406	Transport and Storage of Chemical Energy Carriers *First usage possible from 4/1/2020.*	4 CR
M-CIWVT-105407	Additive Manufacturing for Process Engineering *First usage possible from 4/1/2020.*	6 CR

1.4 Specialized Course I

Credits
16

Election block: Specialized Course I (1 item)	
Applied Rheology	16 CR
Gas Particle Systems	16 CR
Mechanical Process Engineering	16 CR
Environmental Process Engineering	16 CR
Thermal Process Engineering	16 CR
Product Design	16 CR
Chemical Process Engineering	16 CR
Fuel Technology	16 CR
Technical Thermodynamics	16 CR
Food Process Engineering	16 CR
Water Technology	16 CR
Combustion Technology	16 CR
Technical Biology	16 CR
Energy Process Engineering	16 CR
Biopharmaceutical Process Engineering	16 CR
Bioresource Engineering	16 CR
Energy and Combustion Technology *First usage possible from 10/1/2019.*	16 CR

1.4.1 Applied Rheology

Part of: Specialized Course I

Credits
16

Election block: Applied Rheology (at least 16 credits)		
M-CIWVT-104322	Fluid Mechanics of Non Newtonian Fluids	8 CR
M-CIWVT-104326	Rheology and Rheometry	4 CR
M-CIWVT-104327	Dimensional Analysis of Fluid Mechanic Problems	4 CR
M-CIWVT-104328	Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids	4 CR
M-CIWVT-104329	Rheology of Polymers	4 CR
M-CIWVT-104330	Stability of Disperse Systems	4 CR
M-CIWVT-104331	Rheology of Complex Fluids and Advanced Rheometry	4 CR
M-CIWVT-104335	Rheology and Processing of Polymers	8 CR
M-CIWVT-104336	Rheology and Processing of Disperse Systems	8 CR
M-CIWVT-104350	Microfluidics	4 CR
M-CIWVT-104370	Drying Technology	6 CR
M-CIWVT-104402	Formulation Processes for Life Sciences	4 CR
M-CIWVT-104886	Principles of Ceramic and Powder Metallurgy Processing	4 CR
M-CIWVT-105205	Microfluidics and Case Studies	6 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from 4/1/2020.*	6 CR

1.4.2 Gas Particle Systems

Part of: Specialized Course I

Credits
16

Election block: Gas Particle Systems (at least 16 credits)		
M-CIWVT-104292	Fluidized Bed Technology	4 CR

M-CIWVT-104327	Dimensional Analysis of Fluid Mechanic Problems	4 CR
M-CIWVT-104337	Gas Particle Measurement Technology	6 CR
M-CIWVT-104338	Fundamentals of Motoric Exhaust Aftertreatment	4 CR
M-CIWVT-104339	Nanoparticles – Structure and Function	6 CR
M-CIWVT-104340	Gas Particle Separation Processes	6 CR
M-CIWVT-104345	Data Analysis and Statistics	4 CR
M-CIWVT-104973	Digitization in particle technology	4 CR

1.4.3 Mechanical Process Engineering

Part of: Specialized Course I

Credits
16

Election block: Processes for Particle Engineering (at least 16 credits)		
M-CIWVT-103073	Processing of Nanostructured Particles	6 CR
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	6 CR
M-CIWVT-104327	Dimensional Analysis of Fluid Mechanic Problems	4 CR
M-CIWVT-104338	Fundamentals of Motoric Exhaust Aftertreatment	4 CR
M-CIWVT-104339	Nanoparticles – Structure and Function	6 CR
M-CIWVT-104340	Gas Particle Separation Processes	6 CR
M-CIWVT-104342	Solid Liquid Separation	8 CR
M-CIWVT-104345	Data Analysis and Statistics	4 CR
M-CIWVT-104347	Bioprocess Development	4 CR
M-CIWVT-104350	Microfluidics	4 CR
M-CIWVT-104351	Process Instruments and Machinery and their Process Integration	4 CR
M-CIWVT-104353	Materials for Electrochemical Storage	4 CR
M-CIWVT-104401	NMR for Engineers	6 CR
M-CIWVT-104402	Formulation Processes for Life Sciences	4 CR
M-CIWVT-104452	Surface Effects in Process Engineering	4 CR
M-MATH-102932	Numerical Methods in Fluid Mechanics	4 CR
M-MATH-102938	Project Centered Software-Lab	4 CR
M-CIWVT-104560	Instrumental Analysis	4 CR
M-CIWVT-104489	Sol-Gel Processes	4 CR
M-CIWVT-104337	Gas Particle Measurement Technology	6 CR
M-CIWVT-104973	Digitization in particle technology	4 CR
M-CIWVT-105205	Microfluidics and Case Studies	6 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from 4/1/2020.*	6 CR

1.4.4 Environmental Process Engineering

Part of: Specialized Course I

Credits
16

Election block: Environmental Process Engineering (at least 16 credits)		
M-CIWVT-103407	Water Technology	6 CR
M-CIWVT-104289	Fuel Technology	6 CR
M-CIWVT-104320	Environmental Biotechnology	4 CR
M-CIWVT-104338	Fundamentals of Motoric Exhaust Aftertreatment	4 CR
M-CIWVT-104340	Gas Particle Separation Processes	6 CR
M-CIWVT-104352	Process and Plant Safety	4 CR
M-CIWVT-104453	Energy and Environment	8 CR
M-BGU-104917	Wastewater Treatment Technologies *First usage possible from 4/1/2019.*	6 CR

M-CIWVT-105200	Liquid Transportation Fuels	6 CR

1.4.5 Thermal Process Engineering

Part of: Specialized Course I

Credits 16

Election block: Thermal Process Engineering (at least 16 credits)		
M-CIWVT-103051	Heat Transfer II	6 CR
M-CIWVT-103059	Statistical Thermodynamics	6 CR
M-CIWVT-103074	Theory of Turbulent Flows without and with Superimposed Combustion	4 CR
M-CIWVT-103075	High Temperature Process Engineering	6 CR
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR
M-CIWVT-104354	Refrigeration B - Foundations of Industrial Gas Processing	6 CR
M-CIWVT-104360	Thermodynamics of Phase Equilibria	6 CR
M-CIWVT-104361	Applied Molecular Thermodynamics	6 CR
M-CIWVT-104364	Industrial Crystallization	6 CR
M-CIWVT-104365	Thermal Separation Processes II	6 CR
M-CIWVT-104368	Solar Process Technology	6 CR
M-CIWVT-104369	Mass Transfer II	6 CR
M-CIWVT-104370	Drying Technology	6 CR
M-CIWVT-104371	Heat Exchangers	4 CR
M-CIWVT-104352	Process and Plant Safety	4 CR

1.4.6 Product Design

Part of: Specialized Course I

Credits 16

Election block: Product Design (at least 16 credits)		
M-CIWVT-104263	Food Science and Functionality	4 CR
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	6 CR
M-CIWVT-104326	Rheology and Rheometry	4 CR
M-CIWVT-104329	Rheology of Polymers	4 CR
M-CIWVT-104330	Stability of Disperse Systems	4 CR
M-CIWVT-104339	Nanoparticles – Structure and Function	6 CR
M-CIWVT-104364	Industrial Crystallization	6 CR
M-CIWVT-104402	Formulation Processes for Life Sciences	4 CR
M-CIWVT-104420	Unit Operations and Process Chains for Food of Plant Origin	6 CR
M-CIWVT-104421	Unit Operations and Process Chains for Food of Animal Origin	4 CR
M-CIWVT-104489	Sol-Gel Processes	4 CR
M-CIWVT-104396	Product Design II	4 CR
M-CIWVT-104886	Principles of Ceramic and Powder Metallurgy Processing	4 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from 4/1/2020.*	6 CR

1.4.7 Chemical Process Engineering

Part of: Specialized Course I

Credits 16

Election block: Chemical Process Engineering (at least 16 credits)		
M-CIWVT-104277	Multiphase Reaction Engineering	10 CR
M-CIWVT-104280	Heterogeneous Catalysis II	6 CR
M-CIWVT-104283	Reaction Kinetics	6 CR

M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	6 CR
M-CIWVT-104286	Design of Micro Reactors	6 CR
M-CIWVT-104450	Measurement Techniques in Chemical Processing (including practical course)	6 CR
M-CIWVT-104451	Catalytic Micro Reactors	4 CR
M-CIWVT-104489	Sol-Gel Processes	4 CR
M-CIWVT-104490	Measurement Techniques in Chemical Processing	4 CR
M-CIWVT-104491	Catalytic Micro Reactors (including practical course)	6 CR

1.4.8 Fuel Technology

Part of: Specialized Course I

Credits 16

Election block: Fuel Technology (at least 16 credits)		
M-CIWVT-103069	Combustion Technology	6 CR
M-CIWVT-103075	High Temperature Process Engineering	6 CR
M-CIWVT-104281	Chemical Process Engineering II	4 CR
M-CIWVT-104287	Catalytic Processes in Gas Technologies	4 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104289	Fuel Technology	6 CR
M-CIWVT-104290	Technical Systems for Thermal Waste Treatment	4 CR
M-CIWVT-104291	Refinery Technology - Liquid Fuels	6 CR
M-CIWVT-104292	Fluidized Bed Technology	4 CR
M-CIWVT-104299	Applied Combustion Technology	6 CR
M-CIWVT-104352	Process and Plant Safety	4 CR

1.4.9 Technical Thermodynamics

Part of: Specialized Course I

Credits 16

Election block: Technical Thermodynamics (at least 16 credits)		
M-CIWVT-103059	Statistical Thermodynamics	6 CR
M-CIWVT-103063	Thermodynamics of Interfaces	4 CR
M-CIWVT-103068	Physical Foundations of Cryogenics	6 CR
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	6 CR
M-CIWVT-104354	Refrigeration B - Foundations of Industrial Gas Processing	6 CR
M-CIWVT-104356	Cryogenic Engineering	6 CR
M-CIWVT-104360	Thermodynamics of Phase Equilibria	6 CR
M-CIWVT-104361	Applied Molecular Thermodynamics	6 CR
M-CIWVT-104362	Supercritical Fluid Technology	6 CR
M-CIWVT-104363	Thermo- and Particle Dynamics of Particular Systems	6 CR
M-CIWVT-104365	Thermal Separation Processes II	6 CR
M-CIWVT-104478	Vacuum Technology	6 CR
M-CIWVT-104489	Sol-Gel Processes	4 CR

1.4.10 Food Process Engineering

Part of: Specialized Course I

Credits 16

Election block: Food Process Engineering (at least 16 credits)		
M-CIWVT-103407	Water Technology	6 CR
M-CIWVT-104255	Nutritional Consequences of Food Processing	4 CR

M-CIWVT-104263	Food Science and Functionality	4 CR
M-CIWVT-104319	Microbiology for Engineers	4 CR
M-CIWVT-104370	Drying Technology	6 CR
M-CIWVT-104402	Formulation Processes for Life Sciences	4 CR
M-CIWVT-104420	Unit Operations and Process Chains for Food of Plant Origin	6 CR
M-CIWVT-104421	Unit Operations and Process Chains for Food of Animal Origin	4 CR
M-CIWVT-104257	Practical Course in Food Process Engineering *First usage possible from 10/1/2019.*	2 CR
M-CHEMBIO-104620	Food Chemistry Basics	4 CR
M-CIWVT-105380	Membrane Technologies in Water Treatment *First usage possible from 4/1/2020.*	6 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from 4/1/2020.*	6 CR

1.4.11 Water Technology

Part of: Specialized Course I

Credits 16

Election block: Water Technology (at least 16 credits)		
M-CIWVT-103407	Water Technology	6 CR
M-CIWVT-103441	Biofilm Systems	4 CR
M-CIWVT-104301	Water Quality Assessment	6 CR
M-CIWVT-104302	Structure and Reaction of Aquatic Humic Substances	2 CR
M-CIWVT-104319	Microbiology for Engineers	4 CR
M-CIWVT-104320	Environmental Biotechnology	4 CR
M-CIWVT-104401	NMR for Engineers	6 CR
M-CIWVT-103440	Practical Course in Water Technology *First usage possible from 10/1/2019.*	4 CR
M-CIWVT-104560	Instrumental Analysis	4 CR
M-BGU-104917	Wastewater Treatment Technologies *First usage possible from 4/1/2019.*	6 CR
M-CIWVT-105380	Membrane Technologies in Water Treatment *First usage possible from 4/1/2020.*	6 CR

1.4.12 Combustion Technology

Part of: Specialized Course I

Credits 16

Election block: Combustion Technology (at least 16 credits)		
M-CIWVT-103069	Combustion Technology	6 CR
M-CIWVT-103074	Theory of Turbulent Flows without and with Superimposed Combustion	4 CR
M-CIWVT-103075	High Temperature Process Engineering	6 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104289	Fuel Technology	6 CR
M-CIWVT-104290	Technical Systems for Thermal Waste Treatment	4 CR
M-CIWVT-104293	Energy Technology	4 CR
M-CIWVT-104294	Flow and Combustion Instabilities in Technical Burner Systems	4 CR
M-CIWVT-104295	Combustion and Environment	4 CR
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	4 CR
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR
M-CIWVT-104299	Applied Combustion Technology	6 CR
M-CIWVT-105206	Design of a Jet Engine Combustion Chamber *First usage possible from 10/1/2019.*	6 CR
M-CIWVT-104321	Practical Course Combustion Technology	4 CR

1.4.13 Technical Biology

Part of: Specialized Course I

Credits 16

Election block: Technical Biology (at least 16 credits)		
M-CIWVT-103441	Biofilm Systems	4 CR
M-CIWVT-104268	Bioelectrochemistry and Biosensors	4 CR
M-CIWVT-104273	Commercial Biotechnology	4 CR
M-CIWVT-104274	Industrial Genetics	6 CR
M-CIWVT-104275	Industrial Biocatalysis	6 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104320	Environmental Biotechnology	4 CR
M-CIWVT-104360	Thermodynamics of Phase Equilibria	6 CR
M-CIWVT-104362	Supercritical Fluid Technology	6 CR
M-CIWVT-104422	Processes and Process Chains for Renewable Resources	6 CR
M-CIWVT-104570	Biobased Plastics	4 CR
M-CIWVT-104347	Bioprocess Development	4 CR
M-CIWVT-104398	Fungal Biotechnology	6 CR
M-CIWVT-104399	Biotechnology in Bioeconomy	6 CR

1.4.14 Energy Process Engineering

Part of: Specialized Course I

Credits 16

Election block: Energy Process Engineering (at least 16 credits)		
M-CIWVT-103069	Combustion Technology	6 CR
M-CIWVT-103075	High Temperature Process Engineering	6 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104289	Fuel Technology	6 CR
M-CIWVT-104292	Fluidized Bed Technology	4 CR
M-CIWVT-104293	Energy Technology	4 CR
M-CIWVT-104295	Combustion and Environment	4 CR
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	4 CR
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR
M-CIWVT-104299	Applied Combustion Technology	6 CR
M-CIWVT-105206	Design of a Jet Engine Combustion Chamber *First usage possible from 10/1/2019.*	6 CR
M-CIWVT-104352	Process and Plant Safety	4 CR

1.4.15 Biopharmaceutical Process Engineering

Part of: Specialized Course I

Credits 16

Election block: Biopharmaceutical Process Engineering (at least 16 credits)		
M-CIWVT-103066	Process Modeling in Downstream Processing	4 CR
M-CIWVT-104266	Formulation of (Bio)pharmaceutical Therapeutics	4 CR
M-CIWVT-104268	Bioelectrochemistry and Biosensors	4 CR
M-CIWVT-104272	Biomimetic Interfaces and Bioconjugation	4 CR
M-CIWVT-104273	Commercial Biotechnology	4 CR
M-CIWVT-104342	Solid Liquid Separation	8 CR
M-CIWVT-104347	Bioprocess Development	4 CR
M-MACH-100489	BioMEMS - Microsystems Technologies for Life Sciences and Medicine I	4 CR

M-MACH-100490	BioMEMS - Microsystems Technologies for Life Sciences and Medicine II	4 CR
M-MACH-100491	BioMEMS - Microsystems Technologies for Life Sciences and Medicine III	4 CR
M-MACH-102702	Organ Support Systems	4 CR
M-MACH-102720	Principles of Medicine for Engineers	4 CR
M-CIWVT-104401	NMR for Engineers	6 CR
M-CIWVT-105412	Industrial Aspects in Bioprocess Technology	4 CR

1.4.16 Bioresource Engineering

Part of: Specialized Course I

Credits
16

Election block: Bioresource Engineering (at least 16 credits)		
M-CIWVT-104273	Commercial Biotechnology	4 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104397	Innovation Management for Products & Processes in the Chemical Industry	4 CR
M-CIWVT-104402	Formulation Processes for Life Sciences	4 CR
M-CIWVT-104420	Unit Operations and Process Chains for Food of Plant Origin	6 CR
M-CIWVT-104421	Unit Operations and Process Chains for Food of Animal Origin	4 CR
M-CIWVT-104422	Processes and Process Chains for Renewable Resources	6 CR
M-CIWVT-104570	Biobased Plastics	4 CR
M-CIWVT-103441	Biofilm Systems	4 CR
M-CIWVT-104398	Fungal Biotechnology	6 CR
M-CIWVT-104399	Biotechnology in Bioeconomy	6 CR
M-CHEMBIO-104620	Food Chemistry Basics	4 CR
M-CIWVT-104266	Formulation of (Bio)pharmaceutical Therapeutics	4 CR
M-CIWVT-104342	Solid Liquid Separation	8 CR
M-CIWVT-105380	Membrane Technologies in Water Treatment *First usage possible from 4/1/2020.*	6 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from 4/1/2020.*	6 CR

1.4.17 Energy and Combustion Technology

Part of: Specialized Course I

Credits
16

Note regarding usage
First usage possible from 10/1/2019.

Election block: Energy and Combustion Technology (at least 16 credits)		
M-CIWVT-104290	Technical Systems for Thermal Waste Treatment	4 CR
M-CIWVT-104321	Practical Course Combustion Technology	4 CR
M-CIWVT-105201	Applied Combustion Technology	4 CR
M-CIWVT-105206	Design of a Jet Engine Combustion Chamber	6 CR
M-CIWVT-105207	Energy from Biomass	6 CR
M-CIWVT-105200	Liquid Transportation Fuels	6 CR
M-CIWVT-105202	High Temperature Process Engineering *First usage possible from 4/1/2020.*	4 CR
M-CIWVT-105406	Transport and Storage of Chemical Energy Carriers *First usage possible from 4/1/2020.*	4 CR

1.5 Internship

Credits
14

Mandatory		
M-CIWVT-104527	Internship	14 CR

2 Modules

M 2.1 Module: Additive Manufacturing for Process Engineering [M-CIWVT-105407]

Responsible: Prof. Dr.-Ing. Roland Dittmeyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2020)

Credits	Recurrence	Language	Level	Version
6	Each summer term	English	5	1

Mandatory			
T-CIWVT-110902	Additive Manufacturing for Process Engineering - Examination	5 CR	Dittmeyer
T-CIWVT-110903	Practical in Additive Manufacturing for Process Engineering	1 CR	Dittmeyer

Competence Certificate
Learning control consists of:

- Practical (ungraded)
- Oral examination with a duration of about 30 minutes

Competence Goal
Students are familiar with the concept of a fully digital fabrication chain using and linking together modeling and simulation, computer aided design and 3D printing. They know the most important 3D printing methods suitable for process engineering applications. Moreover, they are able to use standard tools for 3D data generation and they already own hands on practical experience with the use of a metal 3D printer for fabrication of highly precise parts with complex shape.

Module grade calculation
Module grade is the grade of the oral examination.

Content
The rationale for additive manufacturing and key aspects of this approach are explained. An overview of different methods and materials for 3D printing is given with a focus on the use of 3D printed parts or fully functional devices in chemical and process engineering. Tools for 3D data generation for additive manufacturing are introduced and design rules for selected 3D printing methods are explained. Illustrative examples for 3D printed components and functional devices in process engineering are presented and discussed based on literature and own research. In the practical, students will work together in small groups on a fully digital fabrication of functional parts by selective laser melting of metal powder going through a cycle of 3D data generation, 3D printing, and finishing of the printed parts.

Workload
Lectures: 30 h

Practical: 16 h (8 experiments)

Homework: 90 h

Exam Preparation: 44 h

Total: 180 h

Literature

- Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies, Springer Sciennce & Business Media, New York, 2015
- Christoph Klahn, Mirko Meboldt (Hrsg.), Entwicklung und Konstruktion für die Additive Fertigung, Vogel Business Media, Würzburg, 2018

2.2 Module: Applied Combustion Technology [M-CIWVT-104299]

Responsible: Prof. Dr.-Ing. Nikolaos Zarzalis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108839	Applied Combustion Technology	6 CR	Zarzalis

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal

- The students are able to describe and explain the characteristics of the different flames
- The students can apply the combustion characteristics for burner design.
- The students can test burners in order to investigate their operability and analyze the gained results.
- The students are able to evaluate burner operability with regard to the application.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Basic principles of combustion; Fuels; Combustion characteristics; Structure and properties of stationary laminar and turbulent premixed and diffusion flames; Flame stability; Laws of similarity and burner scale-up; Combustion of liquid fuels; Heterogeneous combustion of solid fuels; Examples of industrial burners

Workload

- Attendance time (Lecture): 45 h
- Homework: 25 h
- Exam Preparation: 110 h

Literature

- Joos, Technische Verbrennung
- Warnatz, U. Maas, Technische Verbrennung
- R. Turns, An Introduction to Combustion

2.3 Module: Applied Combustion Technology [M-CIWVT-105201]

Responsible: Dr. Peter Habisreuther
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Energy and Combustion Technology

Credits	Recurrence	Language	Level	Version
4	Each summer term	English	5	1

Mandatory			
T-CIWVT-110540	Applied Combustion Technology	4 CR	Habisreuther

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal

- The students are able to describe and explain the characteristics of the different flames
- The students can apply the combustion characteristics for burner design.
- The students can test burners in order to investigate their operability and analyze the gained results.
- The students are able to evaluate burner operability with regard to the application.

Prerequisites
None

Content
Basic principles of combustion; Fuels; Combustion characteristics; Structure and properties of stationary laminar and turbulent premixed and diffusion flames; Flame stability; Laws of similarity and burner scale-up; Combustion of liquid fuels; Heterogeneous combustion of solid fuels; Examples of industrial burners.

Workload

- Attendance time (Lecture): 30 h
- Homework: 20 h
- Exam Preparation: 70 h

Literature

- Joos, Technische Verbrennung
- Warnatz, U. Maas, Technische Verbrennung
- R. Turns, An Introduction to Combustion

M 2.4 Module: Applied Molecular Thermodynamics [M-CIWVT-104361]

Responsible: Prof. Dr.-Ing. Michael Türk
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-108922	Applied Molecular Thermodynamics	6 CR	Türk

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

Literature
Godnew, I.N.; *Berechnung thermodynamischer Funktionen aus Moleküldaten*; Frohn, A.; *Einführung in die kinetische Gastheorie*

Hirschfelder, J.O., et al.; *Molecular theory of gases and liquids*

M 2.5 Module: Biobased Plastics [M-CIWVT-104570]

Responsible: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Biology
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-109369	Biobased Plastics	4 CR	Kindervater

Competence Certificate
Verteifungsfach:

The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Technisches Ergänzungsfach or a large number of aatudents:

The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).

The grade of the oral examination is the module grade.

Prerequisites
None

Workload
120 h:

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

M 2.6 Module: Bioelectrochemistry and Biosensors [M-CIWVT-104268]

Responsible: Dr. Michael Wörner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Biology
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108807	Bioelectrochemistry and Biosensors	4 CR	Wörner

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Prerequisites
None

Content
Overview of Electrode Processes and Kinetics of Electrode Reactions; Electrochemical Methods (for the Characterization of the EC-Bio-Interface); Bioenergetics and Biological Electron Transport; Electrochemistry of Redox Enzymes; Biosensors and Sensor Applications; Biological Membranes and Membrane Mimics; Biofuel Cells; Organic Electrosynthesis and Bioelectrosynthesis; Photobioelectrochemistry and Biomimetic Photovoltaic Systems

Workload

- Attendance time (Lecture): 24 h
- Homework: 45 h
- Exam Preparation: 90 h

Literature

- Electrochemistry: Principles, Methods, and Applications
- Christopher M.A. Brett, Oxford University Press;
- Bioelectrochemistry: Fundamentals, Experimental Techniques and Applications, Philip Bartlett, John Wiley & Sons
- Bioelectrochemistry, Encyclopedia of Electrochemistry, 11 Volume Set: Encyclopedia of Electrochemistry, Volume 9, Wiley-VCHVerlag GmbH

2.7 Module: Biofilm Systems [M-CIWVT-103441]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Water Technology
Specialized Course I / Technical Biology
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	English	4	1

Mandatory			
T-CIWVT-106841	Biofilm Systems	4 CR	Horn

Competence Certificate
Oral exam, about 20 min

Competence Goal
Students can describe the structure and function of biofilms in natural habitats as well as in technical systems. They can explain the major influencing factors and processes for the formation of biofilms. They are familiar with techniques for visualizing biofilm structures as well as with models for simulating biofilm growth. They are able to select appropriate methods for the analysis of biofilms and to evaluate the habitat conditions.

Module grade calculation
Grande of the module is the grade of oral examination.

Prerequisites
None

Content
Microorganisms typically organize in the form of biofilms in technical and natural aquatic systems. However, biofilms are not only accumulated microorganisms at interfaces: They are bound together by a matrix of extracellular polymeric substances (EPS). In this course, the structure and function of biofilms in different natural habitats and technical applications (biofilm reactors, biofilms in natural waters, biofouling in technical systems and biofilms for power generation in microbial fuel cells) are presented and discussed. Biofilm growth and abrasion as well as models for the simulation of these processes are introduced. Furthermore, microscopic techniques for the visualization of biofilm structures are presented.

Workload
Attendance time: 30 h
Preparation/follow-up: 30 h
Examination + exam preparation: 60 h

2.8 Module: Biomass Based Energy Carriers [M-CIWVT-104288]

Responsible: Dr.-Ing. Siegfried Bajohr
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Combustion Technology
Specialized Course I / Technical Biology
Specialized Course I / Energy Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108828	Energy from Biomass	6 CR	Bajohr

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
The course mediates fundamentals and process engineering aspects of biomass conversion and conditioning processes. The students learn to understand and to evaluate processes for biomass utilization by balancing mass and energy streams. Taking into account regional and global feedstock potentials the students are enabled to choose the most efficient conversion technologies.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Fundamentals on biomass and its production pathways to energy carriers like substitute natural gas (SNG), bio diesel or other fuels.

Production, properties, and characterization of biomass.

Potential and sustainability; energy demand and supply, potentials today and in the future, CO_2 emissions and reduction potential.

Utilization and conversion of biogenic oils and fats.

Biochemical conversion to liquid products like alcohols; fermentation to biogas and its upgrading.

Thermochemical conversion of biomass via pyrolysis and gasification; examples for synthesis processes (FT-, CH_4-, CH_3OH-, DME-synthesis).

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

Literature

- Kaltschmitt, M.; Hartmann (Ed.): Energie aus Biomasse, 2. Aufl., Springer Verlag 2009.
- Graf, F.; Bajohr, S. (Hrsg.): Biogas: Erzeugung – Aufbereitung – Einspeisung, 2. Aufl., Oldenbourg Industrieverlag 2013.

2.9 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine I [M-MACH-100489]

Responsible: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

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

Competence Certificate
Written exam (75 min)

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

Prerequisites
none

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

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

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

M. Madou
Fundamentals of Microfabrication
Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

M 2.10 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine II [M-MACH-100490]

Responsible: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

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

Competence Certificate
Written exam (75 min)

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

Prerequisites
None

Content
Examples of use in Life-Sciences and biomedicine: Microfluidic Systems:
LabCD, Protein Cristallisation
Microarrys
Tissue Engineering
Cell Chip Systems
Drug Delivery Systems
Micro reaction technology
Microfluidic Cells for FTIR-Spectroscopy
Microsystem Technology for Anesthesia, Intensive Care and Infusion
Analysis Systems of Person´s Breath
Neurobionics and Neuroprosthesis
Nano Surgery

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

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

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

M. Madou
Fundamentals of Microfabrication

M 2.11 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine III [M-MACH-100491]

Responsible: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

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

Competence Certificate
Written exam (75 min)

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

Prerequisites
none

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

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

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

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

M. Madou
Fundamentals of Microfabrication

2.12 Module: Biomimetic Interfaces and Bioconjugation [M-CIWVT-104272]

Responsible: Dr. Michael Wörner

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108810	Biomimetic Interfaces and Bioconjugation	4 CR	Wörner

Competence Certificate

The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Module grade calculation

The grade of the oral examination is the module grade.

Prerequisites

None

Content

Design and Applications of biomimetic Membranes; Bioconjugation of Interfaces; Synthesis, Stabilization and Bioconjugation of Nanoparticles; Applications of biofunctionalized Nanoparticles for the Life Sciences; Nanomaterials for Theranostics;

Workload

- Attendance time (Lecture): 24 h
- Homework: 45 h
- Exam Preparation: 90 h

Literature

- Nanotechnologies for the Life Sciences, Vol. 1: Biofunctionalization of Nanomaterials, C. Kumar, Wiley-VCH Verlag GmbH;
- Chemistry of Bioconjugates (Synthesis, Characterization, and Biomedical Applications), R. Narain, John Wiley & Sons;

M 2.13 Module: Biopharmaceutical Purification Processes [M-CIWVT-103065]

Responsible: Prof. Dr.-Ing. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (BIW)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	5	1

Mandatory			
T-CIWVT-106029	Biopharmaceutical Purification Processes	6 CR	Hubbuch

Competence Certificate
The examination is a written examination with a duration of 120 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

Competence Goal
Process development of biopharmaceutical processes

Prerequisites
None

Content
Detailed discussion of biopharmaceutical purification processes

Workload
- Attendance time (Lecture): 60 h
- Homework: 90 h
- Exam Preparation: 30 h

Learning type
- 22705 - Biopharmazeutische Aufarbeitungsverfahren, 3V
- 22706 - Übung zu Biopharmazeutische Aufarbeitungsverfahren, 1Ü

Literature
Vorlesungsskript

M 2.14 Module: Bioprocess Development [M-CIWVT-104347]

Responsible: Michael-Helmut Kopf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Technical Biology
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108902	Bioprocess Development	4 CR	Kopf

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
The Students:

- get familiar with processes and techniques to develop industrial scale, biotech-based processes
- gain insight into the workflow of large scale (double-digit kt/a) industrial bioprocess development
- learn to combine theoretical understanding with practical applications related to relevant industrial systems.

understand relevance of tecno-economic evaluation as a basis for developing competitive processes

Prerequisites
None

Content

- **Process to develop new or alternative, bio-based production process:**
  Ideation, Basic Concept, Critical analysis, Development steps
- **Value Proposition of novel product / process:**
  Quality, Performance, Price, Eco-efficiency, Regional aspects
- **Critical aspects along the development process:**
  Feedstock issues, Design to Cost, Specification and Performance, Regulatory Issues, Eco-efficiency (raw material and energy efficiency)
- **From Lab to Production (focus of lecture):**
  Phases of a development process: Explorative Research, Proof of Principle, Proof of Concept, Scale-up and Apparatus design, Plant design, Production
- **Competitor Intelligence**:
  Competitors with their "own" processes, Alternative products, similar in application
- **Benchmarking as a development tool:**
  Cost Benchmarking, CoP, as a development tool to identify optimization potential
- **Production scenarios:** Own investment, Toller, Production Partner

Workload
120 h:

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

Literature
Skriptum zur Vorlesung

M 2.15 Module: Biotechnological Production [M-CIWVT-104384]

Responsible: Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (BIW)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-106030	Biotechnological Production	6 CR	Syldatk
T-CIWVT-108492	Seminar Biotechnological Production	0 CR	Syldatk

Competence Certificate
The success control consists of two partial services:

- Exam preparation: Seminar lecture of about 10 minutes during the course; Study achievement according to § 4 (3) SPO
- written examination of 120 minutes according to § 4 (2) Nr. 1 SPO

Module grade is the grade of the written exam.

Competence Goal
Students are able to apply the knowledge of processes for the biotechnological production of certain substances on issues relating to new production processes. They identify common principles and laws of the various processes. They can independently solve problems in the development of process schematics and can use the knowledge mediated in the lecture.

Prerequisites
The Seminar "Biotechnological Production" is a precondition for admittance to the written exam.

The following knowledge is required: biochemistry, genetics, cell biology, microbiology.

Content
After giving an overview of the historical development of biotechnology common basic principles of biotechnological production processes are presented. Using recent examples and selected products, processes and methods of industrial or microbial biotechnology, plant cell culture techniques and animal cell culture techniques are presented. Selected examples include e.g. the production of microbial biomass, organic acids, alcohols and ketones, amino acids, vitamins, antibiotics, enzymes, biopolymers, flavorings, natural substances with plant cell cultures, monoclonal antibodies and biopharmaceuticals with animal cell cultures in an industrial scale.

Workload

- Attendance time (Lecture): 60 h
- Homework: 40 h
- Preparation presentation at the seminar: 20 h
- Attendance time (Lecture): 60 h

Literature

- Sahm, G. Antranikian, K.-P. Stahmann, R. Takors (Eds.): Industrielle Mikrobiologie, Springer-Spektrum-Verlag 2012 (ISBN 978-3-8274-3039-7)
- Chmiel (Ed.): Bioprozesstechnik, Springer-Spektrum-Verlag 3. Auflage 2011 (ISBN 978-3-8274-2476-1

M 2.16 Module: Biotechnological Use of Renewable Resources [M-CIWVT-105295]

Responsible: Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108982	Biotechnology in Bioeconomy	4 CR	Syldatk

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
This lecture conveys the role of biotechnological processes in a future bioeconomy. Possible raw materials, their preparation and subsequent biotechnological implementation into energy carriers, platform chemicals and special microbial products are presented.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
After an introduction to the basics of a future bioeconomy and the comparison of chemical and biotechnological industrial processes using renewable resources, their preparation for biotechnological use and their implementation into energy sources (methane, ethanol), platform chemicals (lactate, dicarboxylic acids, amino acids) and special microbial products (polysaccharides, biosurfactants, flavoring substances) and coupling products like bioplastics. The examples of sugar production, papermaking and ethanol production explain various biorefinery concepts.

Workload
Lectures: 45 h

Homework: 45 h

Exam Preparation: 30 h

M 2.17 Module: Biotechnology in Bioeconomy [M-CIWVT-104399]

Responsible: Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Biology
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	2

Mandatory			
T-CIWVT-108982	Biotechnology in Bioeconomy	4 CR	Syldatk
T-CIWVT-110770	Biotechnology in Bioeconomy -Seminar	2 CR	

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
This lecture conveys the role of biotechnological processes in a future bioeconomy. Possible raw materials, their preparation and subsequent biotechnological implementation into energy carriers, platform chemicals and special microbial products are presented.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
After an introduction to the basics of a future bioeconomy and the comparison of chemical and biotechnological industrial processes using renewable resources, their preparation for biotechnological use and their implementation into energy sources (methane, ethanol), platform chemicals (lactate, dicarboxylic acids, amino acids) and special microbial products (polysaccharides, biosurfactants, flavoring substances) and coupling products like bioplastics. The examples of sugar production, papermaking and ethanol production explain various biorefinery concepts.Integrated into the event are presentations by the participants on current developments in the bioeconomy and excursions.

Workload
Lectures: 45 h

Homework: 60 h

Preraration of Seminar: 45 h

Exam Preparation: 30 h

M 2.18 Module: Catalytic Micro Reactors [M-CIWVT-104451]

Responsible: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	5	1

Mandatory			
T-CIWVT-109087	Catalytic Micro Reactors	4 CR	Pfeifer

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Lectures and Exercises: 30 h
- Homework: 50 h
- Exam preparation: 40 h

M 2.19 Module: Catalytic Micro Reactors (including practical course) [M-CIWVT-104491]

Responsible: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-109182	Practical Course Measurement Techniques in Chemical Processing	2 CR	Pfeifer
T-CIWVT-109087	Catalytic Micro Reactors	4 CR	Pfeifer

Competence Certificate
The Examination consists of:

1. Oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO)
2. Ungraded laboratory wokr (section 4 subsection 3 SPO)

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Practical course: 20 h , Elaboration: 30 h
- Homework: 50 h
- Exam Preparation: 50 h

M 2.20 Module: Catalytic Processes in Gas Technologies [M-CIWVT-104287]

Responsible: Dr.-Ing. Siegfried Bajohr
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108827	Catalytic Processes in Gas Technologies	4 CR	Bajohr

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
The students know the relevant catalytic processes in gas technology. Understanding the interaction between thermodynamic, mass and heat transfer and reaction kinetic on the basis of concrete examples enables them to evaluate reactor concepts and develop new approaches for catalytic processes.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Sources, utilization, demand and characterization of gaseous chemical energy carriers.

Catalytic processes for production, conditioning and utilization of gaseous energy carriers. Synthesis and utilization (e. g. methanation and steam reforming); exothermic vs. endothermic processes.

Catalytic processes for gas cleaning and conditioning.

Workload

- Attendance time (Lecture): 30 h
- Homework: 50 h
- Exam Preparation: 40 h

Literature

- Ullmann's Encyclopedia of Industrial Chemistry. Wiley-VCH 2000.
- Jess, A.; Wasserscheid, P.: Chemical Technology. An Integral Textbook, Wiley-VCH 2013.
- Weber, K.: Engineering verfahrenstechnischer Anlagen. Praxishandbuch mit Checklisten und Beispielen. Springer Vieweg 2014.
- Froment, G. F.; Waugh, K. C.: Reaction Kinetics and the Development and Operation of Catalytic Processes, Elsevier 1999.

M 2.21 Module: Chemical Process Engineering II [M-CIWVT-104281]

Responsible: Prof. Dr. Bettina Kraushaar-Czarnetzki
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108817	Chemical Process Engineering II	4 CR	Kraushaar-Czarnetzki

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students know the film model and are able to apply it for the calculation of mass transport effects in reacting multiphase systems. They know technical two- and three-phase reactors with their fields of application and their limits. For multiphase reactors with well-defined properties, they are able to design reactor dimensions and to calculate suitable process conditions.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Theory of mass transfer and reaction in multiphase reacting systems (film model); technical reactors for two-phase systems (gas-liquid, liquid-liquid, gas-solid); reactors for three-phase systems.

Workload

- Attendance time (Lecture): 30 h
- Homework: 50 h
- Exam Preparation: 40 h

Literature

- Kraushaar-Czarnetzki: Skript "Chemische Verfahrenstechnik II";
- Kraushaar-Czarnetzki: Foliensammlung "Heterogene Katalyse I".

Alle Lernmaterialien und Hinweise auf Spezialliteratur sind auf der Lernplattform ILIAS (https://ilias.studium.kit.edu) abgelegt

2.22 Module: Chem-Plant [M-CIWVT-104461]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	5	1

Mandatory			
T-CIWVT-109127	Chem-Plant	4 CR	Enders

Competence Goal
The students are able to apply the knowledge of their academic education for the design of a concretely chemical plant and they are able to publish the obtained results.

Prerequisites
None

Content
Design of a complete chemical plant for the production of selected product, participation on the Chem-Plant competition (organized by VDI)

Workload

- Attendance time (Lecture): 10 h
- Projekt work: 60 h
- Presentations and Conference participation: 50 h

M 2.23 Module: Combustion and Environment [M-CIWVT-104295]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108835	Combustion and Environment	4 CR	Trimis

Competence Certificate
Learning Control is an oral examination with a duration of about 20 minutes.

Competence Goal

- The students are able to describe and explain why it is import to protect environment.
- The students are able to name the major combustion pollutants and describe the effect on the environment.
- The students understand the physicochemical mechanisms of the formation of different pollutants in the combustion process.
- The students are able to name and describe primary measures to reduce emissions.
- The students understand the limitations of primary measures and are able to name and describe secondary measures to reduce emissions.
- The students understand and can assess differences of emissions from engine and gas turbine combustion.

Prerequisites
None

Content

- Importance of environmental protection.
- Combustion pollutants and their effects.
- Pollutant formation mechanisms
- Combustion-related measures (primary measures) to reduce emissions.
- Exhaust gas cleaning: secondary measures to reduce emissions.
- Emissions from engine combustion and from combustion in gas turbines.

Workload
Lectures: 30 h

Homework: 60 h

Exam preparation: 30 h

M 2.24 Module: Combustion Technology [M-CIWVT-103069]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-106104	Combustion Technology	6 CR	Trimis

Competence Certificate
Learning Control is an oral examination with a duration of about 20 minutes (section 4 subsection 2 SPO). Grade of the module is the grade of the oral examination.

Competence Goal

- The students are able to describe and explain the characteristics of the different flame types.
- The students can quantitatively estimate/calculate major combustion characteristics like flame temperature and flame velocity. They further understand the physicochemical mechanisms affecting flammability limits and quenching distances.
- The students understand and can assess the influence/interaction of turbulence, heat and mass transfer to reacting flows.
- The students understand the flame structure and the hierarchical structure of reaction kinetic mechanisms.
- The students understand and can assess the influence of interaction between different time scales of chemical kinetics and fluid flow in reacting flows.
- The students are able to assess and evaluate burner operability with regard to the application.

Prerequisites
None

Content

- Introduction and significance of combustion technology
- Thermodynamics of combustion: Mass and energy/enthalpy balances
- Equilibrium composition
- Flame temperature
- Reaction mechanisms in combustion processes
- Laminar flame velocity and thermal flame theory
- Kinetics related combustion characteristics and experimental characterization: laminar flame velocity, flammability limits, ignition temperature, ignition energy, ignition delay time, quenching distance, flash point, octane and cetane number
- Turbulent flame propagation
- Industrial burner types

Workload

- Lectures and Exercises: 45 h
- Homework: 25 h
- Exam Preparation: 110 h

Literature

- K.K. Kuo: Principles of Combustion, John Wiley & Sons, Hoboken, New York 2005
- J. Warnatz, U. Maas, R.W. Dibble: Combustion, Spinger Verlag, Berlin, Heidelberg 2006
- S.R. Turns: An Introduction to Combustion - Concepts and Applications, McGraw-Hill, Boston 2000
- I. Glassman: Combustion, Academic Press, New York, London 1996

M 2.25 Module: Commercial Biotechnology [M-CIWVT-104273]

Responsible: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Biology
Specialized Course I / Biopharmaceutical Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108811	Commercial Biotechnology	4 CR	Kindervater

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

In case of large number of participants the examination is a written examination with a duration of 60 minutes (section 4 subsection 2 number 1 SPO).

Module grade calculation
The grade of the oral or written examination is the module grade.

Prerequisites
None

Workload
Lectures: 30 h

Homework: 50 h

Exam Preparation: 40 h (about one week)

M 2.26 Module: Computational Fluid Dynamics [M-CIWVT-103072]

Responsible: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-106035	Computational Fluid Dynamics	6 CR	Nirschl

Competence Certificate
The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

Competence Goal
Learning the fundamentals of CFD for the calculation of flow problems.

Prerequisites
None

Content
Navier-Stokes equitations, numerical schemes, turbulence, multiphase flows.

Workload

- Attendance time (Lecture): 64 h
- Homework: 56 h
- Exam Preparation: 601 h

Literature
Nirschl: Skript zur Vorlesung CFD

Ferziger, Peric: Numerische Strömungsmechanik

Oertel, Laurien: Numerische Strömungsmechanik

M 2.27 Module: Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids [M-CIWVT-104328]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108883	Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids	4 CR	Hochstein

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

M 2.28 Module: Cryogenic Engineering [M-CIWVT-104356]

Responsible: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
6	Each winter term	English	4	1

Mandatory			
T-CIWVT-108915	Cryogenic Engineering	6 CR	Grohmann

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Understanding the principle and modelling of regenerative cryocoolers; Understanding and applying of essential engineering methods and components for the conception and design of low-temperature plants and cryostat systems; Understanding of laboratory measurement principles, assessing and applying of sensors and instruments for cryogenic measurement tasks and analysing of measurement uncertainties

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Cryogenic applications; Regenerative cooling with cryocoolers; Fundamentals of low-temperature plant and cryostat design, including fluid mechanics and heat transfer, thermal contacts and thermal insulation, cryogenic pumping of gasses, regulations, design components and safety; General principles of measurement and uncertainties as well as cryogenic temperature, pressure and flow measurement

Workload

- Attendance time (Lecture): 45 h
- Homework: 45 h
- Exam Preparation: 90 h

M 2.29 Module: Data Analysis and Statistics [M-CIWVT-104345]

Responsible: Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108900	Data Analysis and Statistics	4 CR	Guthausen

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
The students are familiar with statistical parameters and are able to judge. Out of the variety of statistical approaches for data analysis they are able to choose the most promising tool for a given question.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Introduction into statistics and its application in data analysis. Descriptive statistics with typical quantities and parameters like standard deviation, distributions and their applications. The application of these tools leads to statistical tests, which are needed in approximation and regression. Chemometric data treatment and statistic processing of large data sets will be studied on the example of multivariate approaches for revealing correlations.

Workload

- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h

2.30 Module: Design of a Jet Engine Combustion Chamber [M-CIWVT-105206]

Responsible: Prof. Dr.-Ing. Nikolaos Zarzalis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2019)
Specialized Course I / Combustion Technology (Usage from 10/1/2019)
Specialized Course I / Energy Process Engineering (Usage from 10/1/2019)
Specialized Course I / Energy and Combustion Technology

Credits	Recurrence	Language	Level	Version
6	Each winter term	English	5	1

Mandatory			
T-CIWVT-110571	Design of a Jet Engine Combustion Chamber	6 CR	Zarzalis

Competence Certificate
Success control is an examination of another kind according to § 4 Abs. 2 Nr. 3 SPO.

The module grade consists of the grade of the oral examination (1/3) and the cooperation / presentation during the project (2/3).

Competence Goal

- The students are able to apply the relevant design parameters in order to design a jet engine combustor.
- The students are able to evaluate design modifications due to the performance of a jet engine combustor.
- The students are able to review literature studies and use them for their design aims.
- The students learn to work target oriented following a time schedule.
- The students learn to work in a team and to exchange information between the teams by definition of interfaces.
- The students learn to present clearly and in an acceptable time the work progress and the most important results.

Prerequisites
None

Content
At the beginning the description and operating mode of a jet engine with emphasis on the combustor is explained in 4 lessons. Afterwards the design of the combustor based on geometrical boundary conditions (engine casing) and the performance conditions will start. The tasks to be solved for the design are the combustor aerodynamic (pressure loss, air split), thermal management (temperature distribution, wall cooling, material), calculation of emissions and the construction of the combustor. In order to solve the tasks the students have to be organized in groups which are responsible for the tasks mentioned. The work progress will be controlled by a time schedule and regular presentations. The complete design will be discussed in a final presentation.

Workload

- Attendance time (Lecture): 30 h
- Homework: 45 h
- Project: 80 h
- Exam Preparation: 45 h

Literature

- Lefebvre, Gas Turbine Combustion
- Rolls-Royce plc, the jet engine
- Müller, Luftstrahltriebwerke Grundlage, Charakteristiken, Arbeitsverhalten

M 2.31 Module: Design of Micro Reactors [M-CIWVT-104286]

Responsible: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	5	1

Mandatory			
T-CIWVT-108826	Design of Micro Reactors	6 CR	Pfeifer

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4, subsection 2, number 2, SPO).

Competence Goal
The students are able apply the methods of process intensification by microstructuring of the reaction zone and are capable of analyzing the advantages and disadvantages while transferring given processes into microreactors. With knowledge of special production processes for micro reactors, students are able to design microstructured systems in terms of heat exchange and to analyze the possibilities of transferring processes from conventional technology into the microreactor with regard to heat transfer performance. They understand also how the mechanisms of mass transport and mixing interact in microstructured flow mixers, and are able to apply this knowledge to the combination of mixing and reaction. They can also analyze possible limitations in the process adaptation and are thus able to design microstructured reactors for homogeneous reactions appropriately. The students understand the significance of the residence time distribution for the conversion and selectivity and are capable of analyzing the interaction of mass transport by diffusion and hydrodynamic residence time in microstructured equipment in given applications.

Prerequisites
None

Content
Basiswissen zu mikroverfahrenstechnischen Systemen: Herstellung von mikrostrukturierten Systemen und Wechselwirkung mit Prozessen, Intensivierung von Wärmetausch und spezielle Effekte durch Wärmeleitung, Verweilzeitverteilung in Reaktoren und Besonderheiten in mikrostrukturierten Systemen, strukturierte Strömungsmischer (Bauformen und Charakterisierung) und Auslegung von strukturierten Reaktoren hinsichtlich Stoff- und Wärmetransport

Workload
Lectures: 45 h

Homework: 42 h

Exam preparation: 60 h (about 1.5 weeks)

Literature

- Skript (Foliensammlung), Fachbücher:
- Kockmann, Norbert (Hrsg.), Micro Process Engineering, Fundamentals, Devices, Fabrication, and Applications, ISBN-10: 3-527-31246-3
- Micro Process Engineering - A Comprehens (Hardcover), Volker Hessel (Editor), Jaap C. Schouten (Editor), Albert Renken (Editor), Yong Wang (Editor), Junichi Yoshida (Editor), 3 Bände, 1500 Seiten, Wiley VCH, ISBN-10: 3527315500
- Winnacker-Küchler: Chemische Technik, Prozesse und Produkte, BAND 2: NEUE TECHNOLOGIEN, Kapitel Mikroverfahrenstechnik S. 759-819, ISBN-10: 3-527-30430-4
- Emig, Gerhard, Klemm, Elias, Technische Chemie, Einführung in die chemische Reaktionstechnik, Springer-Lehrbuch, 5., aktual. u. erg. Aufl., 2005, 568 Seiten, ISBN-10: 3-540-23452-7 (Kapitel Mikroreaktionstechnik S. 444-467)
- Chemical Kinetics, ISBN 978-953-51-0132-1 "Application of Catalysts to Metal Microreactor Systems", P. Pfeifer, http://www.intechopen.com/books/chemical-kinetics/application-of-catalysts-to-metal-microreactor-systems

M 2.32 Module: Development of an Innovative Food Product [M-CIWVT-104388]

Responsible: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	5	1

Mandatory			
T-CIWVT-108960	Development of an Innovative Food Product	6 CR	van der Schaaf

Competence Certificate
Success control is an examination of another kind:

- an oral exam (colloquium) of 20 about minutes
- a written elaboration

Module grade calculation
The module grade: grade of the oral exam and the grade of the Exposé to be prepared.

Prerequisites
None

M 2.33 Module: Digitization in particle technology [M-CIWVT-104973]

Responsible: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-110111	Digitization in particle technology	4 CR	Nirschl

Competence Certificate
Learning control is an oral examination with a duration of about 30 minutes.

Competence Goal
Capability to develop integrated strategies for the digitalization of processes in particle technology. This includes the development of methods but also the application of numerical methods.

Module grade calculation
The Module grade is the grade of the oral examination.

Prerequisites
None

Content
Teaching methods for the systematic development of engineering-scientific digitization strategies for particle technology. This includes the mathematical fundamentals of process simulation and model predictive control as well as basics of online and in-situ process analysis. Furthermore, the metrological acquisition of large amounts of data requires complex evaluation methods for further processing and reduction of the generated data. The basics of multivariate data analysis as well as machine learning are taught. The developments in digitalization in particle technology are supported by various practical examples. In addition to the lecture a practical exercise in the form of a project work takes place.

Workload

- Lecture: 15 h, Exercise: 15 h
- Homework: 60 h
- Exam preparation: 30 h

M 2.34 Module: Dimensional Analysis of Fluid Mechanic Problems [M-CIWVT-104327]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108882	Dimensional Analysis of Fluid Mechanic Problems	4 CR	Hochstein

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload
- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

M 2.35 Module: Drying Technology [M-CIWVT-104370]

Responsible: Prof. Dr.-Ing. Wilhelm Schabel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Thermal Process Engineering
Specialized Course I / Food Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108936	Drying Technology	6 CR	Schabel

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students are able to identify and design a drying process. They will have an overview on the state of the art in drying technology science.

They are able to interpret, evaluate and select a proper drying process.

The qualification goal is to learn proper methods and drying technology basics in order to transfer this fundamental knowledge to new processes and apparatus.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Introduction to drying technology and industrial applications; Modeling of heat mass transfer during drying and modeling of the entire drying process ; Determination of material properties, sorption, diffusion; Determination of typical drying curves and regimes

Fundamentals in polymer film drying and drying of porous materials; Basic principles of spray drying, fluidized bed drying, microwave drying, infrared drying and freeze drying.

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

M 2.36 Module: Economic Evaluation of Capital Projects [M-CIWVT-104390]

Responsible: Prof. Dr.-Ing. Dieter Stapf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Recurrence	Language	Level	Version
2	Each winter term	German	4	1

Mandatory			
T-CIWVT-108962	Economic Evaluation of Capital Projects	2 CR	Stapf

Prerequisites
None

2.37 Module: Energy and Environment [M-CIWVT-104453]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Prof. Dr.-Ing. Dimosthenis Trimis

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Environmental Process Engineering

Credits	Recurrence	Language	Level	Version
8	Each term	German/English	4	2

Election notes

You can elect one of the following components:

"Energie und Umwelt" containing the lectures:

- Verbrennung und Umwelt (german)
- Technical Systems for Thermal Waste Treatment (english)

"Energy and Environment" containing the lectures:

- Applied Combustion Technology (english)
- Technical Systems for Thermal Waste Treatment (english)

Election block: Election Energy and Environment (1 item as well as 8 credits)			
T-CIWVT-109089	Energy and Environment	8 CR	Kolb, Trimis
T-CIWVT-110917	Energy and Environment	8 CR	Kolb, Trimis

Competence Certificate

Learning Control is an oral examination with a duration of about 40 minutes.

Competence Goal

Part "Technical Systems for Thermal Waste Treatment"

The students are enabled to characterize different waste fractions and select suitable technologies for waste to energy conversion based on detailed process understanding and by application of evaluation tool combining economical and ecological aspects. The students gain a profound inside into process operation.

Part "Combustion and Environment"/ "Appli"ed CombustionTechnology"

- The students are able to describe and explain why it is import to protect environment.
- The students are able to name the major combustion pollutants and describe the effect on the environment.
- The students understand the physicochemical mechanisms of the formation of different pollutants in the combustion process.
- The students are able to name and describe primary measures to reduce emissions.
- The students understand the limitations of primary measures and are able to name and describe secondary measures to reduce emissions.
- The students understand and can assess differences of emissions from engine and gas turbine combustion.

Prerequisites

None

Content
Lecture "Technical Systems for Thermal Waste Treatment"

- Waste: definition, specification, potential;
- Basic thermo-chemical processes for waste treatment: pyrolysis, gasification, combustion
- Technical systems for thermal waste treatment:
  - combustion: Grate furnace, rotary kiln, fluidized bed,
  - gasification: fixed bed, fluidized bed, entrained flow
  - pyrolysis: rotary kiln
- Refractory technology
- Legal aspects of waste managemant
- Tools for critical evaluation of waste treatment technologies
- Excursion to industrial sites

Lecture either "Combustion and Environment"

- Importance of environmental protection.
- Combustion pollutants and their effects.
- Pollutant formation mechanisms
- Combustion-related measures (primary measures) to reduce emissions.
- Exhaust gas cleaning: secondary measures to reduce emissions.
- Emissions from engine combustion and from combustion in gas turbines.

or "Applied Combustion Technology"

oder "Applied Combustion Technology"

Basic principles of combustion; Fuels; Combustion characteristics; Structure and properties of stationary laminar and turbulent premixed and diffusion flames; Flame stability; Laws of similarity and burner scale-up; Combustion of liquid fuels; Heterogeneous combustion of solid fuels; Examples of industrial burners.

Workload

- Lectures: 60 h
- Homework: 110 h
- Exam preparation: 70 h

M 2.38 Module: Energy from Biomass [M-CIWVT-105207]

Responsible: Dr.-Ing. Siegfried Bajohr
Prof. Dr. Nicolaus Dahmen

Organisation: KIT Department of Chemical and Process Engineering

Part of: Specialized Course I / Energy and Combustion Technology

Credits	Recurrence	Language	Level	Version
6	Each winter term	English	5	3

Mandatory			
T-CIWVT-110576	Energy from Biomass	6 CR	Bajohr, Dahmen

Competence Certificate
The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

Competence Goal
The course mediates fundamentals and process engineering aspects of biomass conversion and conditioning processes. The students learn to understand and to evaluate processes for biomass utilization by balancing mass and energy streams. Taking into account regional and global feedstock potentials the students are enabled to choose the most appropriate conversion technologies and applications.

Prerequisites
None

Content
All relevant technologies involved in biomass conversion processes for bioenergy production are introduced, also evaluating their state of development and application potential. If necessary, basics of chemistry, thermodynamic equilibrium and/or of reaction kinetic calculations are introduced. In particular, the lecture consists of the following topics.

- Potential of biomass for sustainable bioenergy production, energy demand and supply today and in the future, CO2 emission and its reduction potential
- Production, composition, properties, and characterization of biomass
- Principle production pathways to energy carriers like substitute natural gas (SNG), biodiesel, bioethanol, synthesis gas or other fuels.
- Utilization and conversion of biogenic oils and fats.
- Biochemical conversion to liquid products like alcohols; fermentation to biogas and its upgrading.
- Thermochemical conversion of biomass via combustion, pyrolysis and gasification; synthesis processes for synthetic fuels production (Methane-, Fischer-Tropsch-, Methanol-to-gasoline-, DME-synthesis).
- Biofuels in comparison

By an excursion to the 3-5 MW pilot plant for synthetic fuel production at KIT insight into a technically representative pilot plant is gained.

In the exercises, special and practical aspects of the lecture are investigated in more deepness. The students evaluate mass balances along whole process chains as well as energetic or carbon utilization efficiencies, compare alternative technologies. The results are presented and discussed in the learning group.

Workload

- Attendance time: Lecture 30 h, Seminar 15 h
- Homework, Preparation of Presentation: 75 h
- Exam Preparation: 60 h

Literature

- Kaltschmitt, M.; Hartmann (Ed.): Energie aus Biomasse, 2. Aufl., Springer Verlag 2009.
- Graf, F.; Bajohr, S. (Hrsg.): Biogas: Erzeugung – Aufbereitung – Einspeisung, 2. Aufl., Oldenbourg Industrieverlag 2013.
- Robert C. Brown (Ed.), Christian Stevens (Series Ed.): Thermochemical Processing of Biomass: Conversion into Fuels, Chemicals and Power, ISBN 978-0-470-72111-7, Wiley, 2011

M 2.39 Module: Energy Technology [M-CIWVT-104293]

Responsible: Prof. Dr. Horst Büchner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108833	Energy Technology	4 CR	Büchner

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h

M 2.40 Module: Environmental Biotechnology [M-CIWVT-104320]

Responsible: Andreas Tiehm
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Environmental Process Engineering
Specialized Course I / Water Technology
Specialized Course I / Technical Biology

Credits	Recurrence	Language	Level	Version
4	Each winter term	English	4	1

Mandatory			
T-CIWVT-106835	Environmental Biotechnology	4 CR	Tiehm

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Homework: 45 h
- Exam Preparation: 45 h

M 2.41 Module: Flow and Combustion Instabilities in Technical Burner Systems [M-CIWVT-104294]

Responsible: Prof. Dr. Horst Büchner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Combustion Technology

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108834	Flow and Combustion Instabilities in Technical Burner Systems	4 CR	Büchner

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h

M 2.42 Module: Fluid Mechanics of Non Newtonian Fluids [M-CIWVT-104322]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology

Credits	Recurrence	Language	Level	Version
8	Each term	German	4	1

Mandatory			
T-CIWVT-108874	Fluid Mechanics of Non-Newtonian Fluids	8 CR	Hochstein

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 60 h
- Homework: 140 h
- Exam Preparation: 40 h

M 2.43 Module: Fluidized Bed Technology [M-CIWVT-104292]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108832	Fluidized Bed Technology	4 CR	Rauch

Competence Certificate
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Understanding of fluidized beds, design and calculation of fluidized beds incl. gas distributors, advantages and disadvantages of fluidized beds and industrial applications

Prerequisites
None

Content
Fundamentals of fluidized beds, explanation of bubbling circulating and dual fluidized beds, calculation of minimum fluidization velocity and transport velocity, classification of particles, design of gas distributors, theory of bubbles in fluidized beds, heat transfer, cold flow models and CFD simulation for design of fluidized beds, industrial examples of fluidized beds

Annotation
The course is offered in winter term 18/19. From summer term 19 it will be offered every summer term.

Workload

- Lectures: 30 h
- Homework: 50 h
- exam preparation: 40 h

Literature

- Fluidized Beds, Jesse Zhu, Bo Leckner, Yi Cheng, and John R. Grace, Chapter 5 in Multiphase Flow Handbook. Sep 2005 , ISBN: 978-0-8493-1280-9, https://doi.org/10.1201/9781420040470.ch5
- Glicksman L.R., Hyre M., Woloshun K., “Simplified scaling relationships for fluidized beds” Powder Technology, 77, (1993)
- Werther, Fluidised-Bed Reactors, in Ullmanns Encyclopedia of industrial chemistry, http://dx.doi.org/10.1002/14356007.b04_239.pub2

M 2.44 Module: Food Chemistry Basics [M-CHEMBIO-104620]

Responsible: Prof. Dr. Mirko Bunzel
Organisation: KIT Department of Chemistry and Biosciences
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	5	1

Mandatory			
T-CHEMBIO-109442	Food Chemistry Basics	4 CR	Bunzel

Prerequisites
None

Workload

- Lectures: 30 h
- Homework: 45 h
- exam preparation: 45 h

M 2.45 Module: Food Science and Functionality [M-CIWVT-104263]

Responsible: Prof. Dr. Bernhard Watzl
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Product Design
Specialized Course I / Food Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108801	Food Science and Functionality	4 CR	Watzl

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students should be enabled to evaluate the health-promoting properties of foods and diets based on their nutrient content.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Relevance of nutrition for human health and well-being. Focus will be on macro- and micronutrients (carbohydrates, proteins, lipids, vitamins, minerals, trace elements, dietary fiber, and phytochemicals) and on their structural and metabolic functions. Major food groups (plant-/animal-based) as sources of essential nutrients will be introduced. In addition, functional aspects of foods/food constituents (e. g. cholesterol-lowering, immunostimulatory; reduction of disease risk) will be presented.

Workload

- Attendance time (Lecture): 30 h
- Homework: 45 h
- Exam Preparation: 45 h

M 2.46 Module: Formulation of (Bio)pharmaceutical Therapeutics [M-CIWVT-104266]

Responsible: Prof. Dr.-Ing. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	5	1

Mandatory			
T-CIWVT-108805	Formulation of (Bio)pharmaceutical Therapeutics	4 CR	Hubbuch

Competence Certificate
The examination is an oral examination with a duration of about 15 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
The students will be able to discuss different development routes for the formulation of pharmaceuticals. The implications of different physiologies for the different formulations will be analyzed. Pro's and con's of different formulations and applications are evaluated.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Fundamentals; Development of formulations for pharmaceuticals; Oral, Parenteral, Dermal, Nasal, Pulmonal; Formulation for Biopharmaceuticals

Workload
Lectures: 30 h

Homework: 60 h

Exam preparation: 30 h

M 2.47 Module: Formulation Processes for Life Sciences [M-CIWVT-104402]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Product Design
Specialized Course I / Food Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108985	Formulation Processes for Life Sciences	4 CR	Karbstein

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 1 SPO).

Competence Goal
Students understand specific needs of liquid and solid formulations for life science application. They are able to select appropriate additives and understand their relevance for product preparation and stabilization. They understand and master basics of formulation preparation and cope with the design of suitable processes. They are acquainted with conventional and innovative technologies. They identify correlations between process parameters and product performance. They are able to transfer process knowledge between different products.

Students are able to identify relevant parameters for product performance. They are able to select suitable scientific based characterization methods and can discuss analytic results critically.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Additives and active substances (LV FT1: U. van der Schaaf/LVT):
Substance categories: Properties and molecular structure; Purposes and functionality: Interfacial activity, modulation of viscosity, etc.; Measurement techniques and newest developments

Emulsification and Dispersion Technologies : (LV FT2: H.P. Karbstein/LVT):
Characteristics of liquid formulations; processing objectives; fundamentals of particle desaggregation and disruption as well as droplet break-up; particle and droplet stabilization in liquid continuous phase; apparatus design and operation principle; process design; process and property function for preparation of liquid formulations; characterisation of liquid formulation properties: fundamentals and measurement devices; innovative developments.

Drying of dispersions: (LV FT3: H.P. Karbstein/LVT):
Objectives of drying, fundamentals of product stabilisation for extended shelf life; processes using the example of spray drying: operation principles, apparatus design, process design, process function; fundamentals of powder quality characterization, instant properties, fundamentals and measurement devices; agglomeration for improved instant properties.

Extrusion Technology: (LV FT4: M. A. Emin/LVT):
Fundamentals of extrusion and extruded product design, extrusion equipment, process design, characterization of the products and process (fundamentals of instrumentation and modeling)
This lecture is prerequisite for practical extrusion course, which is offered as an optional course (i.e. NF or VF LVT).

Annotation
2 of the 4 described lectures may be eleceted.

Workload

- Attendance time (Lecture): 30 h
- Homework: 40 h
- Exam Preparation: 20 h

Literature

Vorlesungsskript (KIT Studierendenportal);

Köhler, K., Schuchmann, H. P.: Emulgiertechnik, 3. Auflage, Behr's Verlag, Hamburg, 978-3-89947-869-3, 2012.

Bouvier, J., Campanella, O.H.: Extrusion Processing Technology: Food and Non-Food Biomaterials, Wiley-Blackwell, 2014

McClements, D. J.: Food Emulsions, 3. Auflage, CRC Press, 978-1-49872-668-9, 2015

Mezger, T.G.: Das Rheologie Handbuch, 4. Auflage, Vincentz Network, 978-3866308633, 2012

2.48 Module: Fuel Technology [M-CIWVT-104289]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Environmental Process Engineering
Specialized Course I / Fuel Technology
Specialized Course I / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108829	Fuel Technology	6 CR	Kolb

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
The students are enabled to characterize fuel resources and derived fuels / chemical energy carriers and to critically evaluate the processes for conversion of fuel resources to chemical energy carriers with respect to process technology, economy and ecology

Prerequisites
None

Content
- Overview of fuel resources: coal, oil, gas, biomass – process of formation, resources, consumption
- Mining technology
- Characterization and analysis of fuel resources and fuels
- Basics and processes for conversion of fuel resources into chemical energy carriers / fuels
- Processes of fuel conversion: power / heat, mobility, synthesis
- Tools for critical evaluation of process chains: LCA, ecoefficiency analysis

Workload
- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

Literature
- "Die Veredlung und Umwandlung von Kohle Technologien und Projekte 1970 bis 2000 in Deutschland"; ISBN 978-3-936418-88-0
- „Grundlagen der Gastechnik“; ISBN 978-3446211094
- “Handbook of Fuels”; ISBN 978-3-527-30740-1
- „Ullmann's Encyclopedia of Industrial Chemistry“; ISBN 978-3-5273-0673-2

M 2.49 Module: Fundamentals of Motoric Exhaust Aftertreatment [M-CIWVT-104338]

Responsible: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Environmental Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108893	Fundamentals of Motoric Exhaust Aftertreatment	4 CR	Dittler

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Students develop an understanding for the challenges of engine exhaust aftertreatment on the basis of the taught basics of the composition of engine emissions. They are able to define application-specific solutions for emission reduction and know the main problems in the operating behavior of the respective components (oxidation catalyst, particle filter, SCR catalyst, ammonia slip catalyst). Students learn to classify current issues objectively and to evaluate them independently.

Prerequisites
None

Content

- Composition of combustion engine exhaust gases
- Legal framework conditions
- Oxidation catalysts: design, function & layout
- Particle reduction – exhaust aftertreatment with particle filters: design, function & layout of particle filters; soot removal; aging by ash deposits; ash removal
- Nitrogene oxide reduction – exhaust aftertreatment by selective catalytic reduction: basic reactions; possible reducing agents; AdBlue® – specification & decompostion; characterization of applied catalysts
- Combined exhaust aftertreatment systems – design & function
- Safety and vehicle related aspects of exhaust aftertreatment integration into the vehicle

Workload

- Attendance time (Lecture): 30 h
- Homework: 50 h
- Exam Preparation: 40 h

M 2.50 Module: Fungal Biotechnology [M-CIWVT-104398]

Responsible: Dr. Katrin Ochsenreither
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Biology
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108981	Fungal Biotechnology	4 CR	Ochsenreither
T-CIWVT-110355	Fungal Biotechnology - Laboratory	2 CR	Ochsenreither

Competence Certificate
Learning control consists of:

1. Prerequisite: Laboratory and short presentation.
2. Oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

Module grade calculation
Module grade is the grade of oral examination.

Prerequisites
Successfully completed microbiological laboratory.

Workload

- Lectures and Exercises: 30 h
- Homework, Presentation: 50 h
- Exam preparation: 60 h
- Lab: 40 h

Literature
Lehrbuch Fungi: Biology and Applications, Third Edition, Wiley.

2.51 Module: Gas Particle Measurement Technology [M-CIWVT-104337]

Responsible: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108892	Gas Particle Measurement Technology	6 CR	Dittler

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students can independently solve questions concerning gas particle measurement technology by knowledge of the required analysis steps and choice of a particle measurement technology suitable for the task at hand.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Aspects of particle measurement technology; sampling; sample preparation; dispersion; imaging measurement methods; counting methods; separation methods, spectroscopy, gas analysis.

Workload

- Attendance time (Lecture): 60 h
- Homework: 90 h
- Exam Preparation: 30 h

M 2.52 Module: Gas Particle Separation Processes [M-CIWVT-104340]

Responsible: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Environmental Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108895	Gas Particle Separation Processes	6 CR	Meyer

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (single examination) or 20 minutes (comprehensive examination in VF Gas-Partikel-Systeme) (section 4 subsection 2 number 2 SPO).

Competence Goal
Students develop an understanding for the basic physical processes that can be used for the (size dependent) separation of particles from a carrier gas flow, and become acquainted with related types of separation apparatus. They are able to identify the crucial operational and process conditions needed for a preselection of suitable separation devices for a specific separation task. They can describe quantitatively the influence of the main operational and process parameters on separation efficiency and energy consumption of an individual apparatus. The students learn to detect practical problems in the operation of separation devices, and they can identify procedures to overcome these issues.

They are therefore able to independently select the most suitable device and the corresponding operational mode for a specific separation task.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content

- Fundamentals:
  - Basic quantitative description of separation processes
  - Elementary theory for classifiers and separators
  - Criteria for selection and evaluation of a separation apparatus
  - Legal framework
- Specific separators for gas particle systems:
  - Functionality, design, fields of application, limitations, practical examples
  - Approximate quantitative calculation of separation efficiency and energy consumption for exemplary classification or separation tasks
  - Types of devices that are described in the lecture:
    - Classifiers in gravity and centrifugal force fields
    - Centrifugal separators (gas cyclone)
    - Filtering separators
    - Wet separators (Scrubbers)
    - Electrical separators (Electrostatic precipitators)

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

2.53 Module: Heat Exchangers [M-CIWVT-104371]

Responsible: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108937	Heat Exchangers	4 CR	Wetzel

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students know essential calculation methods for the dimensioning and verification of heat exchangers and are able to apply them to engineering problems. Students can independently use design methodologies for heat exchangers and perform the necessary calculations of heat transfer coefficients.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
types of heat exchangers, mean logarithmic temperature, efficiency-NTU-methodology, cell methodology, design of heat exchangers, heat transfer in typical heat exchanger geometries, compact heat exchangers, microchannel heat exchangers

Workload

- Attendance time (Lecture): 30 h
- Homework: 50 h
- Exam Preparation: 40 h

M 2.54 Module: Heat Transfer II [M-CIWVT-103051]

Responsible: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	2

Mandatory			
T-CIWVT-106067	Heat Transfer II	6 CR	Wetzel

Competence Certificate
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).
Module grade is the grade of the oral examination.

Competence Goal
Students can deduce the basic differential equations of thermofluiddynamics and know possible simplifications. They know different analytical and numerical solution methods for the transient temperature field equation in quiescent media and are able to use them actively. Students are able to apply these solution methods independently to other heat conduction problems such as the heat transfer in fins and needles.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Advanced topics in heat transfer:

Thermo-fluid dynamic transport equations, transient heat conduction; thermal boundary conditions; analytical methods (combination and separation of variables, Laplace transform); numerical methods (finite difference and volume methods); heat transfer in fins and needles

Workload

- Attendance time (Lecture): 40 h
- Homework: 80 h
- Exam Preparation: 60 h

Literature
Von Böckh/Wetzel: „Wärmeübertragung“, Springer, 6. Auflage 2015

VDI-Wärmeatlas, Springer-VDI, 10. Auflage, 2011

M 2.55 Module: Heterogeneous Catalysis II [M-CIWVT-104280]

Responsible: Prof. Dr. Bettina Kraushaar-Czarnetzki
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	5	1

Mandatory			
T-CIWVT-108816	Heterogeneous Catalysis II	6 CR	Kraushaar-Czarnetzki

Competence Certificate
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Students know the influences of mass and heat transfer resistances on the activity and selectivity of catalysts and on the occurrence of particle/film overheating and multiple operation states. They can develop catalyst designs to avoid transport resistances and high pressure drop. They are capable of selecting reactors and operating conditions for optimum utilization of the catalyst performance.

Prerequisites
None

Content
Influence of mass and heat transfer on the catalytic performance (activity, selectivity, overheating and multiple states); advanced catalyst formulation and shaping technologies for maximum performance; concepts for catalytic reactors; topical case studies on the development and application of heterogeneous catalysts.

Workload

- Attendance time (Lecture): 32 h
- Revision course: 28 h
- Homework: 90 h
- Exam Preparation: 30 h

Literature
Siehe Lernplattform ILIAS (https://ilias.studium.kit.edu).

2.56 Module: High Temperature Process Engineering [M-CIWVT-105202]

Responsible: Prof. Dr.-Ing. Nikolaos Zarzalis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2020)
Specialized Course I / Energy and Combustion Technology (Usage from 4/1/2020)

Credits	Recurrence	Language	Level	Version
4	Each summer term	English	5	1

Mandatory			
T-CIWVT-110912	High Temperature Process Engineering	4 CR	Zarzalis

Competence Certificate
The examination is an oral examination with a duration of 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
The students learn to identify the requirement of high temperature plants. Applying the balance equations for heat and mass and taking into account the relevant chemical kinetic processes they can derive the main process parameters. They are able to select the appropriate reactors and the plant components. Hence the students can evaluate different industrial processes and develop solutions for new problems in the area of high temperature process engineering.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
High temperature (HT) processes and plants; principles and technologies for heat generation; heat generation by combustion; heat transport by radiation; calculation of heat transfer in in high temperature processes; Examples of HT plants

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

Literature

- Kramer, A. Mühlbauer „Praxishandbuch Thermoprozess-Technik, Band I“
- von Starck, A. Mühlbauer, C. Kramer „Praxishandbuch Thermoprozess-Technik, Band II“
- D. E. Rosner „Transport processes in chemically reacting flow systems”

M 2.57 Module: High Temperature Process Engineering [M-CIWVT-103075]

Responsible: Prof. Dr.-Ing. Dieter Stapf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Fuel Technology
Specialized Course I / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-106109	High Temperature Process Engineering	6 CR	Stapf

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

M 2.58 Module: Hydrogen and Fuel Cell Technologies [M-CIWVT-104296]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108836	Hydrogen and Fuel Cell Technologies	4 CR	Trimis

Competence Certificate
Learning control is an oral examination with a duration of about 20 minutes, SPO section 4, subsection 2.

Competence Goal

- The students are able to identify similarities and differences between different fuel cell systems.
- The students are able to assess different fuel cell systems based on the thermodynamic fundamentals.
- Students can describe chemical and process fundamentals of fuel cell systems and, based on this, name conditions for their use.
- The students are able to name and assess hydrogen production processes.
- The students are able to identify and assess specific problem areas of hydrogen and fuel cell technology.

Module grade calculation
The module grade ist the grade of oral examination.

Prerequisites
None

Content

- Introduction and thermo-dynamic basics
- PEM fuel cells
- Molten carbonate fuel cells (MCFC)
- Solid oxide fuel cells (SOFC)
- Fuel cells for liquid and solid fuels
- Hydrogen as an energy carrier
- Hydrogen production
- Electrolysis
- Steam reforming
- Partial oxidation
- Liquid fuel reforming process
- Conversion/purification of carbon monoxide
- Desulphurization
- Fuel cell systems: peripheral components and integration.

Workload
Attendance time: 30 h

Homework: 60 h

Exam Preparation: 30 h

Literature

- Ledjeff-Hey, K.; Mahlendorf, F.; Roes, J.: Brennstoffzellen; Entwicklung, Technologie, Anwendung. C. F. Müller Verlag GmbH, Heidelberg 2001; ISBN 3-7880-7629-1
- Na, Woon Ki: Fuel cells : modeling, control, and applications. CRC Press; Boca Raton u.a. 2010, ISBN 978-1-4200-7161-0
- Vielstich, W.; Lamm, A.; Gasteiger, H.A.: Handbook of Fuel Cells – Fundamentals, Technology and Applications. J. Wiley & Sons, Chichester UK, 2003, ISBN 0-471-49926-9
- Shekhawat, Spivey, Berry: Fuel cells: technologies for fuel processing. Elsevier, Amsterdam, 2011; ISBN 978-0-444-53563-4
- Hoogers, G (editor): Fuel Cell Technology Handbook. CRC Press, Boca Raton, London; 2003; ISBN: 0-8493-0877-1
- U.S. Department of Energy: Fuel Cell Handbook. 7th edition 2004. http://www.netl.doe.gov/File%20Library/research/coal/energy%20systems/fuel%20cells/FCHandbook7.pdf

M 2.59 Module: Industrial Aspects in Bioprocess Technology [M-CIWVT-105412]

Responsible: Prof. Dr.-Ing. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	5	1

Mandatory			
T-CIWVT-110935	Industrial Aspects in Bioprocess Technology	4 CR	Hubbuch

Competence Certificate
The examination is an oral examination with a duration of about 15 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students can discuss and analyze challenges and aspects in the biopharmaceutical industry.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content

- Industrial Aspects on process development.

Workload

- Lectures: 30 h
- Homework: 60
- Exam preparation: 30

M 2.60 Module: Industrial Biocatalysis [M-CIWVT-104275]

Responsible: Dr. Jens Rudat
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Biology

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108813	Industrial Biocatalysis	6 CR	Rudat

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
The students are enabled to critically compare and evaluate different processes leading to industrially relevant products (chemo- vs. biocatalysis as well as various biocatalytic procedures among each other).

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Current developments of enzyme-catalyzed production as well as already established procedures:

- Pharma industries (synthesis and modification of drugs)
- Food and feed industries (enzymatic conversion of ingredients, production of flavour enhancers)

In addition to the presentation of enzymatic reactions and their molecular-biological optimization, also aspects of process engineering are discussed such as choice and design of solvents/reaction media, downstream processing, as well as economic and ecologic factors.

Workload
- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

Literature
- Recent publications in relevant journals, e.g. Applied Microbiology and Biotechnology
- Buchholz, Kasche, Bornscheuer: Biocatalysts and Enzyme Technology; 2nd edition 2012, Wiley-Blackwell; ISBN: 978-3-527-32989-2
- Drautz, Gröger, May: Enzyme Catalysis in Organic Synthesis; 3rd edition 2012, Wiley-Blackwell; ISBN: 978-3-527-32547-4

2.61 Module: Industrial Crystallization [M-CIWVT-104364]

Responsible: Prof. Dr.-Ing. Matthias Kind
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Product Design

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-108925	Industrial Crystallization	6 CR	Kind

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Acquisition of deep understanding of processes using the example of industrial crystallization. Transfer of this understanding into a numerical model.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Crystallization processes and apparatus; Solubility, nucleation and growth kinetics; Modeling and Simulation of the particle size distribution in continuous and batch operated crystallizers; Numerical methods for solving the coupled mass and population balance; Apparatus design, determination of the principal dimensions of forced circulation crystallizers.

Workload

- Attendance time (Lecture): 40 h
- Homework: 70 h
- Exam Preparation: 70 h

Literature

- Gnielinski, V.; Mersmann, A.; Thurner, F. Verdampfung, Kristallisation, Trocknung; Vieweg, 1993
- Mersmann, A.; Kind, M.; Stichlmair, J. Thermische Verfahrenstechnik, 2nd ed.; Springer, 2005
- Mullin, J. W. Crystallization, 3rd ed.; Butterworth-Heinemann, 1993
- Randolph, A. D.; Larson, M. A. Theory of particulate processes; Academic Press, 1971

M 2.62 Module: Industrial Genetics [M-CIWVT-104274]

Responsible: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Biology

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-108812	Industrial Genetics	6 CR	Neumann

Competence Goal
Students will be able to explain and describe the basic methods of genetic engineering mentioned above, such as methods of DNA recombination, sequencing and PCR; manipulation of gene expression in prokaryotes; production of heterologous proteins in prokaryotic and eukaryotic hosts; targeted mutagenesis and protein design; and metabolic engineering. The methods can be applied to similar problems and proposed solutions can be developed.

In the preparation of the seminar presentation, the students show that texts describing such methods can be analyzed and the industrial applicability of these methods can be critically discussed.

Prerequisites
None

Content
Lecture: Fundamentals of genetic engineering with respect to its industrial applicability; methods of DNA recombination, sequencing and PCR; manipulation of gene expression in prokaryotes; production of heterologous proteins in prokaryotic and eukaryotic hosts; targeted mutagenesis and protein design; genetically modified microorganisms in industry; production of pharmaceutically active proteins such as e.g. Insulin or interferon, antibiotic production, molecular diagnostics, production of antibodies, vaccines and therapeutics; metabolic engineering - optimization of substance production by genetic engineering methods.

Seminar: 10 min Lecture on a current example from industrial genetic engineering. Topics will be provided.

2.63 Module: Innovation Management for Products & Processes in the Chemical Industry [M-CIWVT-104397]

Responsible: Dr. Claudius Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108980	Innovation Management for Products & Processes in the Chemical Industry	4 CR	Neumann

Competence Certificate
The examination is a written examination (multiple choice) with a duration of about 30 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

Competence Goal
The students get to know the structures of the chemical industry.

They receive an insight into the interpretation of business figures and their connection with innovations.

They know how different factors influence innovation strategies.

They get to know the expiry of an innovation process.

The students have the opportunity to utilize the presented methods and tackle problems which are close to industrial application.

Besides the students receive an insight into the work of an innovation management (excursion).

Prerequisites
None

Content

Background

The chemical industry had to adapt to the economic conditions of globalization during the last decades. It has been aligned to global markets thus changing the formerly scientific-technology oriented R&D. Today the work in industrial product & process development requires skills besides a thorough knowledge about chemistry and technology: a good general economic understanding combined with the competence to manage a complex system based on business figures. This competence allows scientifically and technology educated scientists and engineers to align chemical product and process development within the Innovation Strategy to the strategic business plan. It is implemented within the Innovation Process and monitored and managed by characteristic performance indicators. Thus, the economic benefit of innovation can be quantified using quantitative measures.

Scope of the lecture

The lecture intends to provide the fundamentals for understanding Innovation Management and to utilize them by tackling examples close to industrial application. The course addresses the following key questions:

What are the structures in the chemical industry?

What are business figures? How are they interpreted and applied in terms of innovation?

What are customers? How do they influence innovation?

How do marketing and product management determine innovation?

What is a business strategy? How is it connected to the innovation strategy?

What is the Innovation Process? How is it managed?

What is Innovation Portfolio Management? Why is it needed for successful innovation?

What are state of the art Innovation Management practices in the chemical industry?

Visit

The lecture includes a one day visit to the Evonik Site Hanau for experiencing current Innovation Management practices from discussions with managers in the chemical industry.

Workload

- Attendance time (Lecture): 30 h (Block lectures 4 days)
- Homework: 60 h
- Exam Preparation: 30 h

M 2.64 Module: Instrumental Analysis [M-CIWVT-104560]

Responsible: Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Water Technology

Credits	Recurrence	Language	Level	Version
4	Each summer term	German/English	4	1

Mandatory			
T-CIWVT-106837	Instrumental Analysis	4 CR	Guthausen

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
The students are familiar with the important methods of modern instrumental analytics and their range of application. They can explain and critically compare the underlying physical principles of the methods. Students are able to develop solution concepts for analytical problems and to choose adequate methods to answer a specific question.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Introduction to selected methods of modern instrumental analysis, as for example optical methods and magnetic resonance methods. Imaging techniques such as MRI, µCT and optical microscopy (CLSM and OCT) and fundamentals of data and image analysis are presented. The focus is on a clear presentation of the physico-chemical fundamentals and the underlying principles as well as the fields of application.

Workload

- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h

Literature
References are given in the respective context in the lecture.

M 2.65 Module: Integrated Bioprocesses [M-CIWVT-104386]

Responsible: Prof. Dr. Clemens Posten
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (BIW)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	5	1

Mandatory			
T-CIWVT-106031	Integrated Bioprocesses	6 CR	Posten

Competence Certificate
The examination is a written examination with a duration of 120 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

Competence Goal
Integrated view of bioprocesses including biology, process engineering, system dynamics. Students can creatively develop new bioprocesses in an interlaced way.

Prerequisites
None

Content
Introduction and discussion of current bioprocesses;

Heterotrophic bioprocesses, phototrophic bioprocesses;

Integration mechanisms between molecule, cell, process steps, product and society

Workload
- Attendance time (Lecture): 60 h
- Homework: 60 h
- Exam Preparation: 60 h

Learning type
22946 – Integrierte Bioprozesse

Literature
- Posten: Integrated Bioprocesses, De Gruyter, Berlin; Skript
- Chmiel et al.: Bioprozesstechnik, Springer Spektrum, Heidelberg

M 2.66 Module: Internship [M-CIWVT-104527]

Responsible: Dr.-Ing. Siegfried Bajohr
Dr.-Ing. Barbara Freudig

Organisation: KIT Department of Chemical and Process Engineering

Part of: Internship

Credits	Recurrence	Language	Level	Version
14	Each term	German	4	1

Mandatory			
T-CIWVT-109276	Internship	14 CR	Bajohr, Freudig

Prerequisites
None

Workload
12 weeks (420 h - 480 h)

M 2.67 Module: Kinetics and Catalysis [M-CIWVT-104383]

Responsible: Prof. Dr. Bettina Kraushaar-Czarnetzki
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-106032	Kinetics and Catalysis	6 CR	Kraushaar-Czarnetzki

Competence Certificate
The examination is a written examination with a duration of 60 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

Competence Goal
Students are introduced to the kinetics of molecular transport and reaction. They learn about catalysis as a kinetic phenomenon. They are able to analyze and interpret the kinetics of homogeneously, enzymatically and heterogeneously catalyzed processes.

Prerequisites
None

Content
Kinetic theory of gases; molecular transport in gases and liquids; diffusivity in porous solids; molecular interactions and Lennard-Jones potential; kinetics of homogeneous reactions; adsorption at solid surfaces and sorption kinetics; elements of the kinetics of catalyzed reactions (homogeneous acid-base, enzymatic and heterogeneous catalysis).

Workload

- Attendance time (Lecture): 42 h
- Revision course: 28 h
- Homework: 80 h
- Exam Preparation: 30 h

Literature

- Kraushaar-Czarnetzki: Skript (https://ilias.studium.kit.edu);
- W. Atkins: Physical Chemistry (Oxford University Press, 1998);
- B. Bird, W.E. Stewart, E.N. Lightfoot: Transport Phenomena (Wiley, 2007)
- C. Gates: Catalytic Chemistry (Wiley, 1992)
- Ertl: Reactions at Solid Surfaces (Wiley, 2009)

M 2.68 Module: Liquid Transportation Fuels [M-CIWVT-105200]

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Environmental Process Engineering
Specialized Course I / Energy and Combustion Technology

Credits	Recurrence	Language	Level	Version
6	Each summer term	English	5	1

Mandatory			
T-CIWVT-110307	Chemical Fuels	6 CR	Rauch

Competence Certificate
Learning Control is an oral examination with a duration of about 20 minutes (SPO section 4 subsection 2).

Competence Goal
The students are enabled to balance modern processes for the production of liquid fuels and to put them into context of a modern refinery. Actual alternative processes fro the production of liquid fuels, their advantages and disadvantages have to be understood.

Module grade calculation
Grade of the Module ist the grade of oral examination.

Prerequisites
None

Content
Introduction to Chemical Fuels (resources, global and regional consumption, CO2 emissions, characterization of raw materials and products, overview of conversion processes; petroleum refining: characterization of crude oils and refinery products, physical separation processes, chemical conversion processes (cracking, hydrotreating, reforming, H2 production etc); liquid fuels from renewable sources (biomass, renewable electricity); gaseous fuels; gasification of solid fuels; economic aspects and perspectives.

Workload

- Lectures and Exercises: 30 h
- Homework: 60 h
- Exam praparation: 30 h

Literature

- Elvers, B. (Ed.): Handbook of Fuels, Energy Sources for Transportation, Wiley VCH 2008.
- Lucas, A. G. (Ed.): Modern Petroleum Technology, Vol. 2 Downstream, John Wiley 2000.
- Gary, J.; Handwerk, G., Kaiser, M. J.: Petroleum Refining, Technology and Economics, Fifth Edition, CRC Press 2007

M 2.69 Module: Mass Transfer II [M-CIWVT-104369]

Responsible: Prof. Dr.-Ing. Wilhelm Schabel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108935	Mass Transfer II	6 CR	Schabel

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

M 2.70 Module: Materials for Electrochemical Storage [M-CIWVT-104353]

Responsible: Prof. Dr. Jens Tübke
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108913	Materials for Electrochemical Storage	4 CR	Tübke

Competence Certificate
The examination is an oral examination with a duration about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students know the basic principles of electrochemical storage devices as well as the electrochemical basics. They are able to calculate the expected properties and operating parameters for given material combinations of electrochemical cells. Students are also able to evaluate appropriate materials and engineering processes for future battery chemistries in a critical way and are able to indicate possible application fields. For different mobile or stationary applications of electrochemical storage devices, students are able to select a suitable type of electrochemical energy storage device and are capable to configure a suitable system configuration.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Electrochemical basics
Introduction to electrochemistry, electrochemical potentials, concentration dependence, electrochemical methods

Fundamentals of electrochemical storage systems
Structure and functioning of primary and secondary batteries
Volta battery / Leclanche-element, alkaline, zinc-carbon, lead-acid, zinc-air, nickel-cadmium, nickel-metal hydride, redox flow batteries, high-temperature batteries, lithium ion batteries, new storage systems (e.g. Li-O, Li-S)
Structure and function of Super capacitors, hybrid systems

Materials and methods for electrochemical storage
Intercalation and conversion electrodes, polymer and ceramic separators
Electrolyte additives and electrode coatings
Liquid and solid electrolyte systems
Conducting materials (metals, modified plastics), housing materials

Design of electrochemical storage systems
Cells and battery development, temperature control, construction and connection technology
Housing and application integration

Operation and applications of electrochemical storage systems
Battery management, determination of operating parameters, aging behavior of batteries, battery selection for specific application profiles

Workload

- Attendance time (Lecture): 30 h
- Homework: 80 h
- Exam Preparation: 10 h

M 2.71 Module: Measurement Techniques in Chemical Processing [M-CIWVT-104490]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	5	1

Mandatory			
T-CIWVT-109086	Measurement Techniques in Chemical Processing	4 CR	Müller

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students are capable to discuss various mesurement methods and are able to compare and analyse different masurement principles.

Due to the mentioned aims, students are able to criticise and rate various measurement methods.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Theory and practice of online measurement methods e.g.: pressure, temperature, pH value and material properties for example: density.

Workload

- Attendance time (Lecture): 22,5 h
- Homework: 26 h
- Exam Preparation: 80 h

M 2.72 Module: Measurement Techniques in Chemical Processing (including practical course) [M-CIWVT-104450]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	5	1

Mandatory			
T-CIWVT-109086	Measurement Techniques in Chemical Processing	4 CR	Müller
T-CIWVT-109181	Practical Course Measurement Techniques in Chemical Processing	2 CR	Müller

Competence Certificate
The examination consists of:

1. Oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).
2. Ungraded Laboratory work (section 4 subsection 3 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Students are capable to discuss various mesurement methods and are able to compare and analyse different masurement principles.

Due to the mentioned aims, students are able to criticise and rate various measurement methods.

Prerequisites
None

Content
Theory and practice of online measurement methods e.g.: pressure, temperature, pH value and material properties for example: density.

Workload

- Attendance time (Lecture): 22,5 h
- Internship: 11.5 h, 8 attempts
- Homework: 26 h
- Exam Preparation: 120 h

M 2.73 Module: Measurement Techniques in the Thermo-Fluid Dynamics [M-CIWVT-104297]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108837	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR	Trimis

Competence Certificate
Learning Control is an oral examination with a duration of about 20 minutes (section 4 subsection 2 SPO).

Competence Goal

- The students are able to plan an experiment, select the appropriate quantities to be measured and identify the appropriate dimensionless numbers for the universal representation of the results.
- The students have a thorough understanding of several advanced measuring techniques used for basic research in thermofluids. They are able to select the most appropriate technique for an experimental study.
- The students can assess the accuracy and limitations of measuring techniques quantitatively.
- The students understand the different time scales of involved phenomena and the stochastic nature of experiments, measuring techniques and turbulent flows. They are able to accurately process acquired measurement data in the time and in the spectral domain.

Module grade calculation
Grade of the module is the grade of the oral examination.

Prerequisites
None

Content

- Design of experiment and dimensional analysis
- Flow visualization (light sheet techniques, shadowgraphy, Schlieren and interferometry)
- Laser Doppler Anemometry
- Phase Doppler Anemometry
- Particle Image Velocimetry
- Laser Induced Fluorescence
- Absorption spectroscopy
- Overview of further techniques
- Data processing for turbulent flows in the time and spectral domain

Workload

- Lectures and Exercises: 45 h
- Homework: 25 h
- Exam Preparation: 110 h

Literature

- C. Tropea, Handbook of Experimental Fluid Mechanics, Springer, Heidelberg, 2007
- M. Zlokarnik, Dimensional Analysis and Scale-up in Chemical Engineering, Springer, Berlin, 1991
- A. C. Eckbreth, Laser Diagnostics for Combustion Temperature and Species, Taylor & Francis Ltd, New York, 1996
- K. Kohse-Höinghaus, J. B. Jeffries, Applied Combustion Diagnostics, Taylor & Francis Ltd, New York, 2002
- H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, Wiley, New York, 1999

M 2.74 Module: Membrane Technologies in Water Treatment [M-CIWVT-105380]

Responsible: Prof. Dr. Harald Horn
Dr.-Ing. Florencia Saravia

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course (Usage from 4/1/2020)
Specialized Course I / Food Process Engineering (Usage from 4/1/2020)
Specialized Course I / Water Technology (Usage from 4/1/2020)
Specialized Course I / Bioresource Engineering (Usage from 4/1/2020)

Credits	Recurrence	Language	Level	Version
6	Each summer term	English	5	1

Mandatory			
T-CIWVT-110864	Excursions: Membrane Technologies	1 CR	Horn, Saravia
T-CIWVT-110865	Membrane Technologies in Water Treatment	5 CR	Horn, Saravia

Competence Certificate
Oral exam, 30 min
Ungraded learning control as a prerequisite for the exam.

Competence Goal
Students have a fundamental knowledge on membrane technology in water and waste water treatment. They learn how the different membrane systems (reverse osmosis, nanofiltration, ultrafiltration, microfiltration, and dialysis) have to be applied to produce a certain water quality. They are able to design such systems.

Module grade calculation
Grade of the module is the grade of oral examination.

Prerequisites
None

Content

- The solution-diffusion model
- Concentration polarization and the consequences for membrane module design.
- Membrane production and properties.
- Membrane configuration and design
- Membrane systems for desalination and brackish water treatment
- Membrane bio reactors for waste water treatment
- Biofouling, scaling and prevention of both
- Excursions with introduction: applied membrane processes in waste water disposal and drinking water supply.

Recommendation
Module „Water Technology (PA221)"

Workload
Attendance time: Lectures: 30 h; Exercises/ excursions: 15 h
Preparation/follow-up: 60 h
Examination + exam preparation: 75 h

Literature

- Melin, T., Rautenbach, R., 2007. Membranverfahren - Grundlagen der Modul- und Anlagenauslegung. Springer Verlag Berlin Heidelberg.
- Mulder, M.H., 2000. Basic Principles of Membrane Technology. Kluwer Academic, Dordrecht.
- Schäfer, A.I., 2005. Nanofiltration: Principles and Applications. Elsevier, Oxford.
- Staude, E., 1992. Membranen und Membranprozesse. Verlag Chemie, Weinheim.
- Vorlesungsunterlagen in ILIAS

M 2.75 Module: Microbiology for Engineers [M-CIWVT-104319]

Responsible: Prof. Dr. Thomas Schwartz
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering
Specialized Course I / Water Technology

Credits	Recurrence	Language	Level	Version
4	Each summer term	English	4	1

Mandatory			
T-CIWVT-106834	Microbiology for Engineers	4 CR	Schwartz

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Homework: 50 h
- Exam Preparation: 40 h

M 2.76 Module: Microfluidics [M-CIWVT-104350]

Responsible: Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	3

Mandatory			
T-CIWVT-108909	Microfluidics	4 CR	Leneweit

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Acquisition of capacities for the development of microfluidic systems and their investigation

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Definition of the term „microfluidics“, physics of miniaturization, scales in micro and nanofluicics, introduction to fabrication methods, fluid dynamics of microfluidic systems, basic equations of fluid mechanics, creeping flows, electrohydrodynamics of microsystems, electroosmosis, electrophoresis and DNA sequencing, diffusion, mixing and separation in microsystems, interfacial phenomena and multiphase flows in microsystems, digital microfluidics and microfluidic systems

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

Literature
Skriptum zur Vorlesung

M 2.77 Module: Microfluidics and Case Studies [M-CIWVT-105205]

Responsible: Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	5	1

Mandatory			
T-CIWVT-108909	Microfluidics	4 CR	Leneweit
T-CIWVT-110549	Microfluidics - Case Studies	2 CR	Leneweit

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Acquisition of capacities for the development of microfluidic systems and their investigation

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Definition of the term „microfluidics“, physics of miniaturization, scales in micro and nanofluicics, introduction to fabrication methods, fluid dynamics of microfluidic systems, basic equations of fluid mechanics, creeping flows, electrohydrodynamics of microsystems, electroosmosis, electrophoresis and DNA sequencing, diffusion, mixing and separation in microsystems, interfacial phenomena and multiphase flows in microsystems, digital microfluidics and microfluidic systems

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 35 h
- Case Studies: 60 h

Literature
Skriptum zur Vorlesung

M 2.78 Module: Microrheology and High Frequency Rheology [M-CIWVT-104395]

Responsible: Dr.-Ing. Claude Oelschlaeger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Recurrence	Language	Level	Version
2	Each summer term	German	4	1

Mandatory			
T-CIWVT-108977	Microrheology and High Frequency Rheology	2 CR	Oelschlaeger

Prerequisites
None

Workload

- Attendance time (Lecture): 15 h
- Homework: 35 h
- Exam Preparation: 10 h

M 2.79 Module: Mixing, Stirring, Agglomeration [M-CIWVT-105399]

Responsible: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2020)
Specialized Course I / Applied Rheology (Usage from 4/1/2020)
Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2020)
Specialized Course I / Product Design (Usage from 4/1/2020)
Specialized Course I / Food Process Engineering (Usage from 4/1/2020)
Specialized Course I / Bioresource Engineering (Usage from 4/1/2020)

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	5	1

Mandatory			
T-CIWVT-110895	Mixing, Stirring, Agglomeration	6 CR	Nirschl

Competence Certificate
Learning control is an oral individual examination with a duration of 30min according SPO section 4, subsection 2.

Competence Goal
The students are able to explain the fundamental laws and the derived physical principles of mixing, stirring and the particle agglomeration and not only to relate them to the principally suited processes but also to selected apparatuses. They have the ability to apply the relationship between product, operation and design parameters to different processes. They can analyse the related process engineering problems with scientific methods and give alternative problem solution proposals. On the basis of their skills they can evaluate whether and if applicable a promising process can be designed.

Module grade calculation
The module grade ist the grade of oral examination.

Prerequisites
None

Content
Fundamentals and applications; statistic methods to characterize the mixing quality; characterisation of the flow properties of bulk solids and liquids; introduction into dimension analysis to achieve characteristic numbers important for mixing problems; scale-up procedures for specific mixing processes; solids mixing processes like free-fall, pusher and intensive mixers, fluidised bed, air jet, and turnover mixers; pile mixing techniques; fluid-mixing processes like homogenisation, suspending, emulsifying, gassing and heat transfer; static mixers and kneaders. adhesion forces between particles; agglomerate properties: characterisation of agglomerates regarding size, size distribution, porosity, density, stability, flow behaviour and instantiation behavior; agglomeration processes like roll-agglomeration, mixing agglomeration, fluidized bed and spray agglomeration, agglomeration in liquids by means of coagulation, flocculation or changed wettability, press agglomeration by means of tabletting, roller compaction or extrusion and post hardening of agglomerates by means of sintering.

Workload
Lectures: 3 SWS/ 45 h
Homework: 75 h
Exam preparation: 60 h

Total: 180 h

M 2.80 Module: Modern Analysis Techniques for Process Optimization [M-CIWVT-104387]

Responsible: Marc Regier
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Recurrence	Language	Level	Version
2	Each summer term	German	4	1

Mandatory			
T-CIWVT-108959	Modern Analysis Techniques for Process Optimization	2 CR	Regier

Competence Certificate
The examination is an oral examination with a duration of 15 - 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Prerequisites
None

2.81 Module: Module Master Thesis [M-CIWVT-104526]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Prof. Dr. Reinhard Rauch

Organisation: KIT Department of Chemical and Process Engineering

Part of: Master Thesis

Credits	Recurrence	Language	Level	Version
30	Each term	German/English	4	2

Mandatory			
T-CIWVT-109275	Master-Thesis	30 CR	Karbstein, Rauch

Prerequisites

Process Technology and at least three further modules of the advanced fundamentals has to be passed. The intership has to be passed. The examination board decides on exceptions.

(Compare SPO section 14 subsection 1)

Modeled Conditions

The following conditions have to be fulfilled:

1. You have to fulfill 3 of 10 conditions:
    1. The module M-CIWVT-103064 - Selected Formulation Technologies must have been passed.
    2. The module M-CIWVT-104386 - Integrated Bioprocesses must have been passed.
    3. The module M-CIWVT-104384 - Biotechnological Production must have been passed.
    4. The module M-CIWVT-103065 - Biopharmaceutical Purification Processes must have been passed.
    5. The module M-CIWVT-103072 - Computational Fluid Dynamics must have been passed.
    6. The module M-CHEMBIO-104486 - Physical Chemistry (incl. Lab) must have been passed.
    7. The module M-CIWVT-103058 - Thermodynamics III must have been passed.
    8. The module M-CIWVT-104383 - Kinetics and Catalysis must have been passed.
    9. The module M-CIWVT-104378 - Particle Technology must have been passed.
    10. The module M-CIWVT-104377 - Thermal Transport Processes must have been passed.
2. The module M-CIWVT-104374 - Process Technology must have been passed.
3. The module M-CIWVT-104527 - Internship must have been passed.

Workload

Homework: 900 h

M 2.82 Module: Multiphase Reaction Engineering [M-CIWVT-104277]

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Recurrence	Language	Level	Version
10	Each winter term	German	5	1

Mandatory			
T-CIWVT-108815	Multiphase Reaction Engineering	10 CR	Kraushaar-Czarnetzki

Competence Certificate
The examination is an oral examination with a duration of 40 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Students know the film model and are able to apply it for the calculation of mass transport effects in reacting multiphase systems. They know technical two- and three-phase reactors with their fields of application and their limits. For multiphase reactors with well-defined properties, they are able to design reactor dimensions and to calculate suitable process conditions.

Students are familiar with the functions of heterogeneous catalysts and are able to apply kinetic models to interpret catalytic effects. They know technical manufacturing techniques and can discuss their impact on catalyst properties. Furthermore, students know important physical-chemical and functional characterization methods, and they are able to use characterization data for a qualified assessment of the applicability and performance of heterogeneous catalysts.

Prerequisites
None

Content
Theory of mass transfer and reaction in multiphase reacting systems (film model); technical reactors for two-phase systems (gas-liquid, liquid-liquid, gas-solid); reactors for three-phase systems.

Functions and kinetic effects of catalysts; structure, manufacturing and forming/shaping of heterogeneous catalysts; physico-chemical properties (composition, morphological and mechanical properties, specific total and partial surface areas, porosity and pore size distribution, surface chemistry) and their characterization; functional characterization (activity, selectivity).

Workload

- Attendance time (Lecture): 70 h
- Revision course: 30h
- Homework: 120 h
- Exam Preparation: 80 h

Literature

- Kraushaar-Czarnetzki: Skript "Chemische Verfahrenstechnik II";
- Kraushaar-Czarnetzki: Foliensammlung "Heterogene Katalyse I".

Alle Lernmaterialien und Hinweise auf Spezialliteratur sind auf der Lernplattform ILIAS (https://ilias.studium.kit.edu) abgelegt.

M 2.83 Module: Nanoparticles – Structure and Function [M-CIWVT-104339]

Responsible: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Product Design

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-108894	Nanoparticles – Structure and Function	6 CR	Meyer

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes in case of a single module examination and 20 minutes in case of a overall examiation of the specialized course (section 4 subsection 2 number 2 SPO).

Competence Goal
Students develop an understanding of the correlation between structure of nanoscaled systems and their physical properties. Additionally, they understand how process parameters in the synthesis of nanoscaled particle systems determine the resulting particle structure.

Based on the knowledge of the structure-function-relationships and of the synthesis routes, the students can develop strategies for the systematic generation and optimization of nanoparticulate systems for specific applications.

Module grade calculation
The module grade ist the grade of oral examination.

Prerequisites
None

Content

- Technical and historical classification of the lecture content
- Methods for visualization of nanoscaled objects and structures
- Description and physical basis of specific properties of nanoscaled particles (and other structures / shapes)
  - Size dependency of surface energy
  - Modification of the phase transition temperature (compared to the bulk phase)
  - Mechanical properties
  - Optical properties
  - electrical properties

- Methods for synthesizing nanoscaled particle systems in the gas phase with well-defined properties
- Relevant process parameters for the adjustment of
  - Particle size (primary particle and agglomerate size)
  - Agglomeration state
  - Agglomerate strength
  - Structure / phase of the particle material
  - Chemical structure of particle surface
  - Multi-level structuring (core-shell, nanoparticles on support structures)

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

M 2.84 Module: NMR for Engineers [M-CIWVT-104401]

Responsible: Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Water Technology
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108984	NMR for Engineers	4 CR	Guthausen
T-CIWVT-109144	Laboratory Work for NMR for Engineers	2 CR	Guthausen

Competence Goal
Knowledge about NMR and their applications, basic understanding of the phenomena

Prerequisites
None

Content
An overview of applications of nuclear magnetic resonance (NMR) will be given together with the basic description of this analytical tool. In the focus of the lectures are typical applications of NMR in chemical and bio engineering. The understanding of this versatile analytical method will be developed on the basis of dedicated examples.

Workload

- Attendance time (Lecture): 30 h
- Revision course: 30 h
- Internship: Atendance Time 30 h, Preparation Time 30 h
- Exam Preparation: 60 h

Literature
Lehrbücher Kimmich und Callaghan, weitere Literatur wird jeweils in der Vorlesung angegeben.

M 2.85 Module: Numerical Methods in Fluid Mechanics (MATHNM34) [M-MATH-102932]

Responsible: Prof. Dr. Willy Dörfler
PD Dr. Gudrun Thäter

Organisation: KIT Department of Mathematics

Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Duration	Level	Version
4	Irregular	2 term	4	1

Mandatory			
T-MATH-105902	Numerical Methods in Fluid Mechanics	4 CR	Dörfler, Thäter

M 2.86 Module: Nutritional Consequences of Food Processing [M-CIWVT-104255]

Responsible: PD Dr. Karlis Briviba
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108792	Nutritional Consequences of Food Processing	4 CR	Briviba

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Homework: 45 h
- Exam Preparation: 45 h

M 2.87 Module: Organ Support Systems [M-MACH-102702]

Responsible: Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-MACH-105228	Organ Support Systems	4 CR	Pylatiuk

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

Competence Goal
Students have fundamental knowledge about functionality of organ support systems and its components. An analysis of historical developments can be done and limitations of current systems can be found. The limits and possibilities of transplantations can be elaborated.

Prerequisites
none

Content

- Introduction: Definitions and classification of organ support and replacement.
- Special topics: acoustic and visual prostheses, exoskeletons, neuroprostheses, tissue-engineering, hemodialysis, heart-lung machine, artificial hearts, biomaterials.

Workload
General attendance: 21 h

Self-study: 99 h

Literature

- Jürgen Werner: Kooperative und autonome Systeme der Medizintechnik: Funktionswiederherstellung und Organersatz. Oldenbourg Verlag.
- Rüdiger Kramme: Medizintechnik: Verfahren - Systeme – Informationsverarbeitung. Springer Verlag.
- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.

M 2.88 Module: Particle Technology [M-CIWVT-104378]

Responsible: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	5	1

Mandatory			
T-CIWVT-106028	Particle Technology Exam	6 CR	Dittler

Competence Certificate
The examination is a written examination with a duration of 120 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

Competence Goal
Students develop an advanced understanding of properties & behavior of particles and particulate systems in important engineering applications; they are able to use this understanding for calculations and design of selected processes

Prerequisites
None

Content
Description and behavior of particles and particulate systems in engineering applications; selected unit operations in particle technology.

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

Learning type
22975 Partikeltechnik Lecture
22976 Übung zu Partikeltechnik Exercises

M 2.89 Module: Physical Chemistry (incl. Lab) [M-CHEMBIO-104486]

Responsible: Dr. Detlef Nattland
Organisation: KIT Department of Chemistry and Biosciences
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	2

Mandatory			
T-CHEMBIO-109178	Physical Chemistry (written exam)	4 CR	Nattland
T-CHEMBIO-109179	Physical Chemistry (lab)	2 CR	Nattland

Competence Certificate
The examination consists of two Parts:

1. written examination with a duration of 60 minutes (section 4 subsection 2 number 1 SPO)
2. practical course, ungraded study achievement (§ 4 Abs. 3 SPO)

Competence Goal
V+Ü: Students unerstand the main basics of quantum mechanics which are necessary for for the application of spectroscopic methods. They can understand and apply selected spectroscopic methods for the evaluation, analysis and solution of problems in engineering sciences.

They understand the thermodynamic formalism for the description of interfacial phenomena. They are able to analyze wetting and dewetting problems, nucleation phenomena as well as ad- and desorption within this formalism.

They can understand and analyze electrochemical cells within thermodynamics of heterogeneous systems with charged particles. They understand transport phenomena of charged particles in solutions. Thy can apply the Debye-Hückel-Theory to thermodynamic and transport phenomena. Using these knowledges they are able acquire and understand more complex electrochemical systems like batteries, fuel cells and corrosion processes.

P: Within the practical course they work on selected projects. Beginning with preparing working steps, over the experimental procedure, to the evaluation of the received data and the written presentation they deepen their knowledge in the field of selected experimental examples. They are able to interpret the results with respect to scientific significance and accuracy.

Prerequisites
None

Content
V+Ü: description of fundamentals and application of physico-chemical subjects relevant for chemical engineering sciences:

Basics of quantum mechanics and its application to spectroscopy, FTIR-absorption spectroscopy, UV-VIS spectroscopy, Raman spectroscopy, NMR spectroscopy;

Thermodynamics of interfaces, Gibbs' adsorption isotherm, adsorption at solid surfaces, Langmuir- and BET adsorption, nucleation theory;

Electrochemistry, thermodynamics of heterogeneous systems with charged particles, electrochemical cells, Debye-Hückel theory, ionic migration in an electric field, technical application of electrochemistry;

P: performance of selected experiments in the field of physical chemistry, improvement of theoretical knowledge focusing on selected topics.

Workload
Attendance time (V+Ü): 3 SWS; 45 h

Homework (V+Ü): 45 h

Exam Preparation: 30 h

Practical Course (4 times): 16 h

Practical Course (pre- and postprocessing) : 44 h

Literature

1. W. Atkins, J. de Paula, Physikalische Chemie (aktuelle Ausgabe), Wiley-VCH, Weinheim;
2. Wedler, Lehrbuch der Physikalischen Chemie (aktuelle Ausgabe), Wiley-VCH, Weinheim;

Begleitend zu Vorlesung und Übung wird ein kompaktes Skriptum zur Verfügung gestellt.

M 2.90 Module: Physical Foundations of Cryogenics [M-CIWVT-103068]

Responsible: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
6	Each summer term	English	4	1

Mandatory			
T-CIWVT-106103	Physical Foundations of Cryogenics	6 CR	Grohmann

Competence Certificate
The examination is an oral examination with a duration of 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Understanding of the mechanisms of entropy generation, and the interaction of the first and the second law in thermodynamic cycles; understanding of cryogenic material properties; application, analysis and assessment of real gas models for classical helium I; understanding of quantum fluid properties of helium II based on Bose-Einstein condensation, understanding of cooling principles at lowest temperatures.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Relation between energy and temperature, energy transformation on microscopic and on macroscopic scales, physical definitions of entropy and temperature, thermodynamic equlibria, reversibility of thermodynamic cycles, helium as classical and as quantum fluid, low-temperature material properties, cooling methods at temperatures below 1 K.

Workload

- Attendance time (Lecture): 45 h
- Homework: 45 h
- Exam Preparation: 90 h

Literature
Schroeder, D.V.: An introduction to thermal physics. Addison Wesley Longman (2000)

Pobell; F.: Matter and methods at low temperatures. 3rd edition, Springer (2007)

M 2.91 Module: Practical Course Combustion Technology [M-CIWVT-104321]

Responsible: Dr.-Ing. Stefan Raphael Harth
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Combustion Technology
Specialized Course I / Energy and Combustion Technology

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	5	1

Mandatory			
T-CIWVT-108873	Practical Course Combustion Technology	4 CR	Harth

Competence Certificate
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO) about experiments.

The grade of the oral examination is the module grade.

Competence Goal
The students are able to analyze results of combustion experiments and to assess the measurements methods.

Prerequisites
None

Content
The laminar flame speed is experimentally determined, stability limits of combustion systems are investigated and the process of combustion is analyzed. Different measurement techniques (e.g. exhaust gas probes or optical measurement techniques) are applied.

Annotation
Dates of experiments by arrangement. Please contatct the responsible person (stefan.harth@kit.edu) for registration by Mai the 15th by the latest.

Workload

- Experiments: 30 h (3 - 4 experiments depending on the complexity of the used test stands)
- Homework, test records: 50 h
- Exam preparation: 40 h

M 2.92 Module: Practical Course in Food Process Engineering [M-CIWVT-104257]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2019)
Specialized Course I / Food Process Engineering (Usage from 10/1/2019)

Credits	Recurrence	Language	Level	Version
2	Each term	German	4	2

Election regulations
Elections in this module must be complete.

Election block: Practical Course in Food Process Engineering (at most 1 item)			
T-CIWVT-109128	Introduction to Sensory Analysis with Practice	2 CR	Eckert, Scherf
T-CIWVT-109129	Seminar of Food Processing in Practice with Excursion	2 CR	Karbstein
T-CIWVT-110577	Research Lab Food Process Engineering	2 CR	Karbstein
T-CIWVT-110578	Internship Food Process Engineering	2 CR	Karbstein

Competence Goal
Students are able to use their academic knowledge on the processing and characterization of food products to evaluate industrially relevant food processes and techniques. In teams, they can discuss and solve complex tasks that concern the production and evaluation of food products and that stem from industrial applications. Students have the skills to present the results of their work in a scientific manner.

Prerequisites
None

Content
One of the following practical courses can be selected:

Introduction to Sensory Analysis with Practice

Fundamentals of Sensory-Physiological Methods: individual sense, basic tastes, unification and standardization, requirements for panel test, training of panel, methods of sensory analysis: difference testing, triangle test, duo-trio test, descriptive tests, evaluation test with scale, etc.

Seminar of Food Processing in Practice with Excursion

Current challenges in the industrial production of selected food products will be discussed in small groups, and presented to the whole class. The seminar will be accompanied by an excursion to the relevant food processing plants.

M 2.93 Module: Practical Course in Water Technology [M-CIWVT-103440]

Responsible: Dr. Gudrun Abbt-Braun
Dr. Andrea Hille-Reichel
Prof. Dr. Harald Horn

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Water Technology (Usage from 10/1/2019)

Credits	Recurrence	Language	Level	Version
4	Each winter term	English	4	3

Mandatory			
T-CIWVT-106840	Practical Course in Water Technology	3 CR	Abbt-Braun, Hille-Reichel, Horn
T-CIWVT-110866	Excursions: Water Supply	1 CR	Abbt-Braun, Horn

Competence Certificate
The learning control consists of:

- Laboratory: 6 Experiments including entrance test, protocol; presentation about a selected experiment (about 15 minutes); final test (SPO section 4, subsection 2 No. 3)
- Excursions, protocols about excursions (ungraded)

Competence Goal
Students can explain the most important processes in water treatment. They are able to do calculations, and to compare and interpret data. They learn how to use different methods, and to interpret different processes.

Module grade calculation
Module grade is the grade of the laboratory and is formed as follows:

A total of 150 points can be achieved:

- maximum 60 points for the experiments (10 each)
- maximum 15 points for the presentation
- maximum 75 points for the final certificate

At least 80 points must be achieved in order to pass.

Prerequisites
Module 'Water Technology (PA221)'

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-CIWVT-103407 - Water Technology must have been started.

Content
6 different experiments out of: equilibrium study of the calcium carbonate system, flocculation, adsorption, oxidation, atomic absorption spectroscopy, ion chromatography, liquid chromatography, sum parameter, and an oral presentation of the student. In addition, excursions to two different treatment plants (waste water, drinking water).

Workload
Attendance time: Introduction and presentation (4 h), 6 Experiments (4 h each), 2 excursions: 36 h
Preparation/follow-up, protocols, presentation: 50 h
Examination + exam preparation: 34 h

Literature

- Harris, D.C., 2010. Quantitative chemical analysis. W. H. Freeman and Company, New York.
- Crittenden, J.C. et al., 2005. Water treatment – Principles and design. Wiley & Sons, Hoboken.
- Patnaik, P., 2010. Handbook of environmental analysis: Chemical pollutants in air, water, soil, and solid wastes. CRC Press.
- Wilderer, P., 2011. Treatise on water science, four-volume set, 1st edition, volume 3: Aquatic chemistry and biology. Elsevier, Oxford.
- Vorlesungsskript im ILIAS
- Praktikumsskript

M 2.94 Module: Principles of Ceramic and Powder Metallurgy Processing [M-CIWVT-104886]

Responsible: Dr. Günter Schell
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Product Design

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	4 CR	Schell

Competence Certificate
Learning control is an oral examination with a duration of 20 - 30 Minutes, SPO section 4 subsection 2.

Competence Goal
The students know the basics of characterization of powders, pastes and suspensions. They have a fundamental understanding of the process technology for shaping of particulate systems. They are able to use these fundamentals to design selected wet- and dry forming processes.

Module grade calculation
Module grade is the grade of oral examination.

Prerequisites
None

Content
The course covers fundamentals of the process technology for shaping of ceramic or metal particle systems. Important shaping methods are reviewed. The focus is on characterization and properties of particulate systems, and, in particular, on process technology for shaping of powders, pastes, and suspensions.

Recommendation
Knowledge of general material science is required.

Workload
- Attendance Time: 30 h
- Homework: 45 h
- Exam preparation: 45 h

Literature
- Folien zur Vorlesung: verfügbar unter http://ilias.studium.kit.edu
- R.J. Brook: Processing of Ceramics I+II, VCH Weinheim, 1996
- M.N. Rahaman: Cermamic Processing and Sintering, 2nd Ed., Marcel Dekker, 2003
- Schatt ; K.-P. Wieters ; B. Kieback. „Pulvermetallurgie: Technologien und Werkstoffe“, Springer, 2007
- R.M. German. “Powder metallurgy and particulate materials processing. Metal Powder Industries Federation,2005
- Thümmler, R. Oberacker. “Introduction to Powder Metallurgy”, Institute of Materials, 1993

M 2.95 Module: Principles of Medicine for Engineers [M-MACH-102720]

Responsible: Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-MACH-105235	Principles of Medicine for Engineers	4 CR	Pylatiuk

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

Competence Goal
Students have fundamental knowledge about functionality and anatomy of organs within different medical disciplines. The students further know about technical methods in diagnosis and therapy, common diseases, their relevance and costs. Finally the students are able to communicate with medical doctors in a way, in which they prevent misunderstandings and achieve a more realistic idea of each others expectations.

Prerequisites
none

Content

- Introduction: Definitions of “health” and “disease”. History of medicine and paradigm shift towards evidence based medicine and personalized medicine.
- Special topics: nervous system, saltatory conduction, musculoskeletal system, cardio-circulatory system, narcosis, pain, respiratory system, sensory organs, gynaecology, digestive organs, surgery, nephrology, orthopaedics, immune system, genetics.

Workload
General attendance: 21 h

Self-study: 99 h

Literature

- Adolf Faller, Michael Schünke: Der Körper des Menschen. Thieme Verlag.
- Renate Huch, Klaus D. Jürgens: Mensch Körper Krankheit. Elsevier Verlag.

2.96 Module: Process and Plant Safety [M-CIWVT-104352]

Responsible: Prof. Jürgen Schmidt

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Environmental Process Engineering
Specialized Course I / Thermal Process Engineering
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108912	Process and Plant Safety	4 CR	Schmidt

Competence Certificate

The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal

The students are able to systematically assess the risks of technical systems, assess the effects of possible accidents and define suitable safety measures. The lecture is divided into thematic blocks. Lecture block 01 is an introduction to the topic:

Lecture block 02 risk management:

- Technical risk analysis
- Requirements for protective devices
- hazardous material facilities
- Create and evaluate plant safety concept

Lecture block 03 hazardous substances:

- Effect / routes of intake of toxic substances
- characeristics of danger
- Safety-related parameters
- Apply the basics of occupational safety

Lecture Block 04 Exothermic Chemical Reactions:

- Recognize the causes of runaway reactions
- Identify and assess dangers
- Assess heat balances of reactors

Lecture block 05 safety devices:

- Types and areas of application of safety devices
- Function and characteristics of safety valves
- Design of safety devices

Lecture block 06 restraint systems:

- Types and areas of application of restraint systems
- Cyclone separators and gravity separators
- Emergency cooling and stop systems

Lecture block 07 Dispersion of hazardous substances:

- Spread of pollutants
- Incident assessment values
- Recommendations for companies
- Assess emergency relief facilities

Lecture block 08 PLT protective devices:

- Classify PLT facilities
- Design of PCT protective devices
- Evaluate the use of existing PCT protective devices

Lecture block 09 explosion protection:

- Explosion areas in two-substance systems / three-substance systems
- Safety-related key figures
- Protective measures to avoid explosions

Lecture block 10 electrostatics:

- Forms of electrostatic charging and discharging of objects and devices
- Protective measures against explosions

Prerequisites

None

Workload

- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h

2.97 Module: Process Instruments and Machinery and their Process Integration [M-CIWVT-104351]

Responsible: Manfred Nagel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108910	Process Instruments and Machinery and their Process Integration	4 CR	Nagel

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Skills to develop holistic processes for product design. Knowledge about task of engineers in process industry.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Teaching of methods and creating awareness about boundary conditions related to scientific and systematic engineering approaches in process development. In Bachelorstudies and during basic studies in process technology focus was laid on the description/analysis of different physical phenomena. Their linkage in the course of selection, dimensioning, interconnection and optimization of apparatuses/ machines and their integration during process development will be outlined and illustrated by a variety of real-life examples.

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

M 2.98 Module: Process Modeling in Downstream Processing [M-CIWVT-103066]

Responsible: Prof. Dr.-Ing. Matthias Franzreb
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-106101	Process Modeling in Downstream Processing	4 CR	Franzreb

Competence Certificate

The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal

Students are able to sum up and explain equilibrium and kinetic equations relevant for chromatography modeling. They are able to explain the methods used for determination of equilibrium and kinetic parameters and can discuss examples. They are familiar with the principle of complex downstream processes, e.g. simulated moving beds, and can explain the differences to conventional chromatography. Using commercial software they are able to simulate chromatography processes and to analyze the results. On this basis they can optimize process parameters and fit them in order to meet given targets such as purity or yield. They can evaluate different processes and choose the variant for a given task.

Prerequisites

None

Content

Fundamentals and practical examples of chromatography modeling,

Design rules for Simulated Moving Beds, Design of Experiments (DOE)

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

M 2.99 Module: Process Technology [M-CIWVT-104374]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (mandatory)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
8	Each term	German	4	1

Mandatory			
T-CIWVT-106148	Practical Course Process Technology and Plant Design	0 CR	Kolb
T-CIWVT-106149	Initial Exam Process Technology and Plant Design	0 CR	Kolb
T-CIWVT-106150	Process Technology and Plant Design Written Exam	8 CR	Kolb

Competence Certificate
The module exam consists of three partial performances:

- A written examination of 180 minutes according to § 4 (2) Nr. 1 SPO
- An internship in process and plant engineering, ungraded study achievement according to § 4 (3) SPO
- An admission exam to the practical course process and plant engineering, ungraded study achievement according to §4 (3) SPO

Module grade is the grade of the written exam.

Competence Goal
The students are enabled to analyze technical processes and plants and describe the process on the basis of P&I-diagrams. They are capable to apply their engineering and process engineering basics on industrial processes and plants. They are prepared to design and evaluate process steps and process chains based on simplistic assumptions and characteristic numbers.

Prerequisites
The initial exam is precondition for the practical course.

Content

- Engineering basics: P&I-diagram, flowsheet simulation, process optimization, safety, economical evaluation
- Application of engineering basics in practical course
- Process engineering in technical application, industrial production processes: e.g. steamcracker, methanol, sulfuric acid, ammonia, cement, pulp

Workload

- Attendance time: 43 h
- Homework: 87 h
- Exam preparation: 80 h
- Internship: Attendance time: 9 h + preparation and follow-up time: 21 h

Literature

- *Ullmann's Encyclopedia of Industrial Chemistry.* Weinheim, Germany: Wiley-VCH Verlag GmbH & Co. KGaA, 2000. ISBN 9783527306732.
- **Baerns, M., et al.** *Technische Chemie.* , erw. Aufl. Weinheim: Wiley-VCH, 2013. ISBN 978-3-527-67409-1.
- **Weber, K.** *Engineering verfahrenstechnischer Anlagen. Praxishandbuch mit Checklisten und Beispielen.* Berlin: Springer Vieweg, 2014. SpringerLink : Bücher. ISBN 978-3-662-43529-8.
- **Perry, R., D. Green und J. Maloney.** *Perry's chemical engineer's handbook.* ed. New York: McGraww-Hill, 1999. ISBN 0-07-049841-5.
- **Levenspiel, O.** *Chemical reaction engineering.* 3rd ed. New York: Wiley, 1999. ISBN 047125424X.

M 2.100 Module: Processes and Process Chains for Renewable Resources [M-CIWVT-104422]

Responsible: Prof. Dr. Nicolaus Dahmen
Prof. Dr.-Ing. Jörg Sauer

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Technical Biology
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-108997	Processes and Process Chains for Renewable Resources	6 CR	Dahmen, Sauer

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
The students become able to:

- understand and assess the technical background of the key elements of process chains for the utilization of renewable resources,
- build up the ability for the development of process chains from biomass production via the conversion processes up to product design,
- apply the lessons learned to develop closed process chains for sustainable production of, as example, platform chemicals or material from renewable resources.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
The course comprises the following contents:

- Introduction to building a common knowledge base, among others the presentation of today's most important utilization pathway for biomass, biomass potentials, future usage scenarios,
- Essential technical fundamentals for biomass processing. The focus is on the use of lignocellulosic biomass. Procedures for pretreatment, biomass decomposition and separation as well as for conversion of the respective fractions are learned,
- Systematics and analysis of process chains with renewable raw materials based on already established processes such as paper or sugar mills. Extension of the concepts to possible future biorefineries,
- In the exercise, parallel to the lecture, the learned will be applied and implemented by development of an exemplary biorefinery. The results will be presented in a semiar.

M 2.101 Module: Processing of Nanostructured Particles [M-CIWVT-103073]

Responsible: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-106107	Processing of Nanostructured Particles	6 CR	Nirschl

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Ability to design a process technology for the manufacturing and production of nanoscale particles

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Development of technical process in particle engineering; particle characterisation, interface engineering, particle synthesis;
Typical processes: grinding, mixing, ganulation, selective separation,
classifying; fundamentals of apparatus and devices; simulation techniques, simulation tools

Workload

- Attendance time (Lecture): 60 h
- Homework: 60 h
- Exam Preparation: 60 h

Literature
Skriptum zur Vorlesung

M 2.102 Module: Product Design II [M-CIWVT-104396]

Responsible: Prof. Dr.-Ing. Matthias Kind
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Product Design

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108979	Product Design II	4 CR	Kind

Competence Certificate
The examination is an oral examination with a duration of 30 minutes.

The grade of the oral examination is the module grade.

Competence Goal
Students have gathered insight into their role and professional tasks during industrial product design.

Prerequisites
None

Content
Continuous product innovation is decisive for the competitiveness of companies. The module introduces to the principle of “conceptual product design”. The principle will be explained by lecturing, by exercising and by viewing and discussing a truly instructive movie on the topic. The understanding of the principle is deepened on the subjects of “crystallization” and “colloidal systems”. The principle of “conceptual product design” comprises on the one hand the notion of a “process function”, which is the functional relation between process parameters and physico-chemical product properties, and on the other hand the notion of a “property function”, which is the functional relation between these properties and the product quality.

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

Literature

- Product Design and Engineering – Best Practices (Ed. U. Bröckel, W. Meier, G. Wagner); Wiley VCH; Weinheim 2007; Vol. 1: Basics and Technologies; Vol. 2: Rawmaterials, Additives and Applications
- Product Design and Engineering – Formulation of Gels and Pastes (Ed. U. Bröckel, W. Meier, G. Wagner); Wiley VCH; Weinheim 2013
- Weitere Vorlesungsbegleitende Unterlagen werden durch jeweilige Dozenten bereitgestellt

M 2.103 Module: Product Development - Methods of Product Development [M-MACH-102718]

Responsible: Prof. Dr.-Ing. Albert Albers
Norbert Burkardt
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each summer term	German/English	4	2

Mandatory			
T-MACH-109192	Methods and Processes of PGE - Product Generation Development	6 CR	Albers, Burkardt, Matthiesen

Competence Certificate
Written examination (processing time: 120 min + 10 min reading time)

Competence Goal
The students are able to ...

- classify product development in companies and differentiate between different types of product development.
- name the relevant influencing factors of a market for product development.
- name, compare and use the central methods and process models of product development within moderate complex technical systems.
- explain problem solving techniques and associated development methods.
- explain product profiles and to differentiate and choose suitable creative techniques of solution/idea generation finding on this basis.
- use design guidelines to create simple technical systems and to explain these guidelines.
- name and compare quality assurance methods; to choose and use suitable methods for particular applications.
- explain the differents methods of design of experiment.
- explain the costs in development process.

Prerequisites
None

Content
Basics of Product Development: Basic Terms, Classification of the Product
Development into the industrial environment, generation of costs / responsibility for costs
Concept Development: List of demands / Abstraction of the Problem Definition / Creativity Techniques / Evaluation and selection of solutions
Drafting : Prevailing basic rules of Design / Design Principles as a
problem oriented accessory
Rationalization within the Product Development: Basics of Development
Management/ Simultaneous Engineering and Integrated Product Development/Development of Product
Lines and Modular Construction Systems
Quality Assurance in early Development Phases : Methods of Quality Assurance
in an overview/QFD/FMEA

Workload
regular attendance: 31.5 h

self-study: 148.5 h

Learning type
Lecture

Tutorial

Literature
Lecture documents
Pahl, Beitz: Konstruktionslehre, Springer-Verlag 1997
Hering, Triemel, Blank: Qualitätssicherung für Ingenieure; VDI-Verlag, 1993

2.104 Module: Project Centered Software-Lab (MATHNM40) [M-MATH-102938]

Responsible: PD Dr. Gudrun Thäter
Organisation: KIT Department of Mathematics
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Duration	Level	Version
4	Each summer term	2 term	4	1

Mandatory			
T-MATH-105907	Project Centered Software-Lab	4 CR	Thäter

Prerequisites
none

M 2.105 Module: Reaction Kinetics [M-CIWVT-104283]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	5	1

Mandatory			
T-CIWVT-108821	Reaction Kinetics	6 CR	Müller

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Students are capable to discuss the cause and the differing elementary steps of homogen reactions, and they are qualified to calculate rate coefficients from experimental studies/data. Because of various examples, students can identify and analyse reactions by different elementary steps and they are capable to evaluate homogen reactions critcally.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Basics: transition state theory, thermodynamics and the relationship to kinetics, active sites and chain reactions.

Application: photochemistry, reactions in solution, polyreactions, autocatalysis and explosions.

Workload

- Attendance time (Lecture): 34 h
- Homework: 16 h
- Exam Preparation: 130 h

M 2.106 Module: Refinery Technology - Liquid Fuels [M-CIWVT-104291]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-108831	Refinery Technology - Liquid Fuels	6 CR	Rauch

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
The students are enabled to balance modern processes for the production of liquid fuels and to put them into context of a modern refinery. This knowledge can be transferred to the evaluation and the development of other processes.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Introduction to liquid chemical fuels: sorces, resources/rerserves, consumption, characteristic properties of raw materials and products, overview of conversion processes.

Petroleum and petroleum refining: characterization of petroleum crude oils and refinery products, physical separation processes, chemical conversion/upgrading processes (chemical equilibrium, rection technology etc.), refinery structures.

Non-conventional liquid fuels e. g. from synthesis processes or biomass feedstocks (vegetable oil and derived fuels, alcohols, synthetic liquid fuels).

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

Literature

- Elvers, B. (Ed.): Handbook of Fuels, Energy Sources for Transportation, Wiley VCH 2008.
- Lucas, A. G. (Ed.): Modern Petroleum Technology, Vol. 2 Downstream, John Wiley 2000.
- Gary, J.; Handwerk, G., Kaiser, M. J.: Petroleum Refining, Technology and Economics, Fifth Edition, CRC Press 2007

2.107 Module: Refrigeration B - Foundations of Industrial Gas Processing [M-CIWVT-104354]

Responsible: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-108914	Refrigeration B - Foundations of Industrial Gas Processing	6 CR	Grohmann

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Understanding the principles of different processes for gas liquefaction and gas separation; Analysing processes in order to reveal the sources of energy demand; Applying the principles of thermodynamics of mixtures and analysing the states of fluids in rectification columns; Assessing the potential of technical concepts from a thermodynamic point of view

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Gas liquefaction processes, process analyses, refrigerators and mixed-refrigerant cycles, gas separation by low-temperature rectification, air separation and extraction of noble gasses, processing and separation of natural gas, ethylene production, processing of H2-enriched gas mixtures, storage and transport of liquefied gasses

Workload

- Attendance time (Lecture): 45 h
- Homework: 45 h
- Exam Preparation: 90 h

M 2.108 Module: Rheology and Processing of Disperse Systems [M-CIWVT-104336]

Responsible: Dr.-Ing. Claude Oelschlaeger
Prof. Dr. Norbert Willenbacher

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Applied Rheology

Credits	Recurrence	Language	Level	Version
8	Each term	German	4	1

Mandatory			
T-CIWVT-108891	Rheology and Processing of Disperse Systems	8 CR	Oelschlaeger, Willenbacher

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 60 h
- Homework: 140 h
- Exam Preparation: 40 h

M 2.109 Module: Rheology and Processing of Polymers [M-CIWVT-104335]

Responsible: Dr.-Ing. Bernhard Hochstein
Prof. Dr. Norbert Willenbacher

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Applied Rheology

Credits	Recurrence	Language	Level	Version
8	Each summer term	German	4	1

Mandatory			
T-CIWVT-108890	Rheology and Processing of Polymers	8 CR	Hochstein, Willenbacher

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 60 h
- Homework: 140 h
- Exam Preparation: 40 h

M 2.110 Module: Rheology and Rheometry [M-CIWVT-104326]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Product Design

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108881	Rheology and Rheometry	4 CR	Hochstein

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

M 2.111 Module: Rheology of Complex Fluids and Advanced Rheometry [M-CIWVT-104331]

Responsible: Dr.-Ing. Claude Oelschlaeger
Prof. Dr. Norbert Willenbacher

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Applied Rheology

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108886	Rheology of Complex Fluids and Advanced Rheometry	4 CR	Oelschlaeger, Willenbacher

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

M 2.112 Module: Rheology of Disperse Systems [M-CIWVT-104391]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Recurrence	Language	Level	Version
2	Each summer term	German	4	1

Mandatory			
T-CIWVT-108963	Rheology of Disperse Systems	2 CR	Willenbacher

Prerequisites
None

Workload

- Attendance time (Lecture): 15h
- Homework: 35 h
- Exam Preparation: 10 h

M 2.113 Module: Rheology of Polymers [M-CIWVT-104329]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Product Design

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-108884	Rheology of Polymers	4 CR	Willenbacher

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

M 2.114 Module: Selected Formulation Technologies [M-CIWVT-103064]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	5	1

Mandatory			
T-CIWVT-106037	Selected Formulation Technologies	6 CR	Karbstein

Competence Certificate
The examination is a written examination with a duration of 120 minutes (section 4 subsection 2 number 1 SPO).

Competence Goal
Students understand specific needs of liquid and solid formulations for life science application. They are able to select appropriate additives and understand their relevance for product preparation and stabilisation. They understand and master basics of formulation preparation and cope with the design of suitable processes. They are aquainted with conventional and innovative technologies. They identifiy correlations between process parameters and product performance. They are able to transfer process knowledge between different products.

Students are able to identify relevant parameters for product performance. They are able to select suitable scientific based characterisation methods and can discuss analytic results critically.

Prerequisites
None

Content
Additives and active substances (LV FT1: U. van der Schaaf/LVT):
Substance categories: Properties and molecular structure; Purposes and functionality: Interfacial activity, modulation of viscosity, etc.; Measurement techniques and newest developments.

Emulsification and Dispersion Technologies : (LV FT2: H.P. Karbstein/LVT)Characteristics of liquid formulations; processing objectives; fundamentals of particle desaggregation and disruption as well as droplet break-up; particle and droplet stabilization in liquid continuous phase; apparatus design and operation principle; process design; process and property function for preparation of liquid formulations; characterisation of liquid formulation properties: fundamentals and measurement devices; innovative developments.

Drying of dispersions: (LV FT3: H.P. Karbstein/LVT)

Objectives of drying, fundamentals of product stabilisation for extended shelf life; processes using the examples of spray drying, drum drying, freeze drying: operation principles, apparatus design, process design, process function; fundamentals of powder quality characterization, instant properties, fundamentals and measurement devices; agglomeration for improved instant properties.

Extrusion Technology: (LV FT4: M. A. Emin/LVT)

Fundamentals of extrusion and extruded product design, extrusion equipments, process design, characterization of the products and process (fundamentals of instrumentation and modeling)

This lecture is prerequisite for practical extrusion course, which is offered as an optional course (i.e. NF or VF LVT).

Workload

- Attendance time (Lecture): 60 h
- Homework: 80 h
- Exam Preparation: 40 h

Literature

Vorlesungsskript (KIT Studierendenportal);

Köhler, K., Schuchmann, H. P.: Emulgiertechnik, 3. Auflage, Behr's Verlag, Hamburg, 978-3-89947-869-3, 2012.

Bouvier, J., Campanella, O.H.: Extrusion Processing Technology: Food and Non-Food Biomaterials, Wiley-Blackwell, 2014

McClements, D. J.: Food Emulsions, 3. Auflage, CRC Press, 978-1-49872-668-9, 2015

Mezger, T.G.: Das Rheologie Handbuch, 4. Auflage, Vincentz Network, 978-3866308633, 2012

M 2.115 Module: Solar Process Technology [M-CIWVT-104368]

Responsible: Dr. Martina Neises-von Puttkamer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-108934	Solar Process Technology	6 CR	Neises-von Puttkamer

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
The students

- Know the special characteristics of solar energy
- Can explain how the various solar concentrating techniques work
- Know how concentrated solar radiation can be coupled into different processes
- Know about different storage systems and how they are integrated into a process
- Know the specific challenge of using solar energy and how to solve them
- Can design simple systems for specific operating conditions and locations

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
The lecture Solar Process Technology describes the use and integration of concentrating solar technology in various high-temperature processes. After the introduction of the basics of solar radiation, the techniques with which direct solar radiation can be concentrated will be explained. The focus of the lecture is on the coupling of solar high-temperature heat in high-temperature processes, which can thus be operated solely or partially solar. Power-generating processes, purely thermal high-temperature processes and chemical processes are explained. From the large number of existing processes, a few examples are selected and the challenges of solar operation as well as the technical implementation are shown. The necessary development steps in different areas, such as materials science, process control and reactor technologies are explained and the development from the laboratory to the pilot scale is clarified. Cross-cutting issues that play a significant role in all processes are the use of storage systems and the hybrid operation of processes. Various thermal and chemical storage systems are discussed and their inclusion in and adaptation to the processes are exemplified. The hybrid operation of processes is explained in more detail.

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

M 2.116 Module: Sol-Gel Processes [M-CIWVT-104489]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Product Design
Specialized Course I / Chemical Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	5	1

Mandatory			
T-CIWVT-108822	Sol-Gel Processes	4 CR	Müller

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students are capable to describe and analyse the complete process from the startin gmaterial (sol) to the finished product (gel), like ceramics.

They are qualified to evaluate and estimate every single step of the entire process critically.

Prerequisites
None

Content
Production of functional material via the sol-gel-process: hydrolyse and condensation, the gel-building process (gelation) and aging, deformation and rhelogy, drying-process, structure of aero- and xerogels, surface-chemistry and modyfication of the surface and finally sintering. Applications: powder, ceramics, glass, membranes and coatings.

Workload

- Attendance time (Lecture): 22,5 h
- Homework: 16 h
- Exam Preparation: 80 h

M 2.117 Module: Sol-Gel-Processes (Including Practical Course) [M-CIWVT-104284]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Product Design
Specialized Course I / Chemical Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108822	Sol-Gel Processes	4 CR	Müller
T-CIWVT-108823	Practical Course Sol-Gel Processes	2 CR	Müller

Competence Certificate
The examination consists of:

1. Oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).
2. Ungraded Laboratory work (section 4 subsectsion 3 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Students are capable to describe and analyse the complete process from the startin gmaterial (sol) to the finished product (gel), like ceramics.

They are qualified to evaluate and estimate every single step of the entire process critically.

Prerequisites
None

Content
Production of functional material via the sol-gel-process: hydrolyse and condensation, the gel-building process (gelation) and aging, deformation and rhelogy, drying-process, structure of aero- and xerogels, surface-chemistry and modyfication of the surface and finally sintering. Applications: powder, ceramics, glass, membranes and coatings.

Workload

- Attendance time (Lecture): 22,5 h
- Internship: 11,5 h, 4 attempts
- Homework: 16 h
- Exam Preparation: 130 h

M 2.118 Module: Solid Liquid Separation [M-CIWVT-104342]

Responsible: Dr.-Ing. Marco Gleiß
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Biopharmaceutical Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
8	Each winter term	German	5	1

Mandatory			
T-CIWVT-108897	Solid Liquid Separation	8 CR	Anlauf

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
The students are able to apply the fundamental laws and the derived physical principles of the particle separation from liquids and not only to relate them to the principally suited separation apparatuses but also special variants. They have the ability to apply the relationship betwen product operation and design parameters to different separation techniques. They can analyse separation problems with scientific methods and give alternative problem solution proposals.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
physical fundamentals, apparatuses, applications,strategies; characterisation of particle systems and slurries; pretreatment methods to enhance the separability of slurries; fundamentals, apparatuses and process technology of static and centrifugal sedimentation, flotation, depth filtration, crossflow filtration, cake forming vacuum and gas overpressure filtration, filter centrifuges and press filters; filter media; selection criteria and scale-up methods for separation apppartuses and machines; apparatus combinations; case studies to solve sparation problems

Workload

- Attendance time (Lecture): 60 h
- Homework: 80 h
- Exam Preparation: 100 h

Literature
Anlauf: Skriptum "Mechanische Separationstechnik - Fest/Flüssig-Trennung"

M 2.119 Module: Stability of Disperse Systems [M-CIWVT-104330]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Product Design

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-108885	Stability of Disperse Systems	4 CR	Willenbacher

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload
- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

2.120 Module: Statistical Thermodynamics [M-CIWVT-103059]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	3

Mandatory			
T-CIWVT-106098	Statistical Thermodynamics	6 CR	Enders

Competence Goal
The students are able to understand the basics of statistical mechanics and they are able to recognize the advantage and disadvantage for application in chemical engineering.

Prerequisites
Thermodynamics III

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-CIWVT-103058 - Thermodynamics III must have been passed.

Content
Boltzmann-method, Gibbs-method, real gases, quations of state, polymers

2.121 Module: Structure and Reaction of Aquatic Humic Substances [M-CIWVT-104302]

Responsible: Dr. Gudrun Abbt-Braun
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Water Technology

Credits	Recurrence	Language	Level	Version
2	Each summer term	German	4	1

Mandatory			
T-CIWVT-108842	Structure and Reaction of Aquatic Humic Substances	2 CR	Abbt-Braun

Competence Certificate
The examination is an oral examination with a duration of about 15 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Students can describe the distribution and the behaviour and the interaction of humic substances in aquatic systems and during water treatment processes. They can explain their major structural functions.

They are familiar with the basic methods to characterize humic substances. They are able to select appropriate methods for the analysis and the determination of humic substances in aquatic systems and to evaluate the results.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Origin, definitions, structure, isolation methods, characterization of humic substances, interaction with other water constituents, behaviour during water treatment processes.

Workload
- Attendance time (Lecture): 15 h
- Homework: 25 h
- Exam Preparation: 20 h

Literature
- Thurman, E. M. (1985): Organic Geochemistry of Natural Waters. Martinus Nijhoff / Dr. W. Junk Publishers, Dordrecht.
- Frimmel, F. H., Abbt-Braun, G. et al. (Hrsg.) (2002): Refractory Organic Substances in the Environment. Wiley-VCH, Weinheim.
- Vorlesungsunterlagen im ILIAS

M 2.122 Module: Supercritical Fluid Technology [M-CIWVT-104362]

Responsible: Prof. Dr.-Ing. Michael Türk
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics
Specialized Course I / Technical Biology

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108923	Supercritical Fluid Technology	6 CR	Türk

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

Literature
Prausnitz, J. M.; Gmehling, J.; VT-Hochschulkurs, 1979 und 1980, Brunner, G.; Gas Extraction, Steinkopff Darmstadt, Springer New York, 1994; McHugh, M. A.; Krukonis, V. J.; Supercritical Fluid Extraction, Butterworth-Heinemann, 1994; M. Türk, Particle Formation with Supercritical Fluids: Challenges and Limitations, 1st ed., Elsevier, Amsterdam **2014**. ISBN: 9780444594860

M 2.123 Module: Surface Effects in Process Engineering [M-CIWVT-104452]

Responsible: Ioannis Nicolaou
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-109088	Surface Effects in Process Engineering	4 CR	Nicolaou

Competence Certificate
Learning control is an oral exmamination with a duration of about 30 minutes.

Competence Goal
A deep understanding of the physico-chemical effects at the surface of the dispersed phase in dispersions and the consideration of their interaction with the dispersity degree as precondition for understanding and optimizing processes involving dispersions.

Module grade calculation
The module grade ist the grade of the oral examination.

Prerequisites
None

Content
Definitions, Applications and stability of dispersions; Molecular – kinetic properties of dispersions: Thermal molecular motion and Brownian motion, Diffusion in solutions and dispersions, sedimentation stability; Adsorption at solid-gas interface: Nature of adsorption forces, Langmuir monomolecular adsorption theory, polymolecular theory of Polany and BET-theory, capillary condensation, chemical adsorption, kinetic of adsorption, influence of the properties of adsorpent and adsorptive on adsorption; Adsorption at solution-gas interface: Surface tension, surface active and inactive substances, Adsorption equation of Gibbs, Shishkovsky-equation and the derivation of Langmuir-equation , effects of the structure and size of tenside molecules, structure of the adsorbed layer; Adsorption at solid-solution interface: Molecular adsorption from the solution, ionic adsorption, wetting phenomena; Electrical properties of dispersions, Introduction to electrokinetic phenomena, structure of the electric double layer (Theories of Helmholz – Perrin, Gouy-Chapman and Stern), Effects of electrolytes on zeta-potential, Electrophoresis and Electroosmosis, Measurement of zeta-potential; Stability and Coagulation of dispersions: Kinetic of coagulation, interparticle energy potential, solvation, structural-mechanical and entropy effects, coagulation through electrolytes, adsorption phenomena and coagulation; Applications in Crystallization and Solid – Liquid Separation.

Annotation
A deep understanding of the physico-chemical effects at the surface of the dispersed phase in dispersions and the consideration of their interaction with the dispersity degree as precondition for understanding and optimizing processes involving dispersions.

Workload
Lectures and Exercises: 30 h

Homework: 60 h

Exam preparation: 30 h

M 2.124 Module: Technical Systems for Thermal Waste Treatment [M-CIWVT-104290]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Combustion Technology
Specialized Course I / Energy and Combustion Technology

Credits	Recurrence	Language	Level	Version
4	Each winter term	English	5	1

Mandatory			
T-CIWVT-108830	Technical Systems for Thermal Waste Treatment	4 CR	Kolb

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
The students are enabled to characterize different waste fractions and select suitable technologies for waste to energy conversion based on detailed process understanding and by application of evaluation tool combining economical and ecological aspects. The students gain a profound inside into process operation.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content

- Waste: definition, specification, potential
- Basic thermo-chemical processes for waste treatment: pyrolysis, gasification, combustion
- Technical systems for thermal waste treatment:
  - combustion: Grate furnace, rotary kiln, fluidized bed
  - gasification: fixed bed, fluidized bed, entrained flow
  - pyrolysis: rotary kiln
  - Refractory technology
  - Legal aspects of waste managemant
  - Tools for critical evaluation of waste treatment technologies
  - Excursion to industrial sites

Workload

- Attendance time (Lecture): 30 h
- Homework: 50 h
- Exam Preparation: 40 h

M 2.125 Module: Technology-Driven Business Start-up – Information for prospective Founders and Interesting Success Stories [M-CIWVT-105210]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	1

Mandatory			
T-CIWVT-110580	Technology-Driven Business Start-up – Information for prospective Founders and Interesting Success Stories	4 CR	Willenbacher

Competence Certificate
Learning control is an oral examination with a duration of about 20 minutes (SPO section 2 subsection 2).

Competence Goal
Enthusiasm for technology-driven business start-up

Basic knowledge about economic and legal aspects of company foundation and state subsidy programs

Basics of making a business plan

Prerequisites
None

Content
Motivation for business start-up

Legal and economic aspects of company foundation

State subsidy programs

Development of a business plan

Technology push, market and customer orientation

Examples of successful business start-up in the fields of chemical engineering, systems engineering and plant construction, energy technology, mobility and aeronautics, innovative materials, renewable energies

Workload
Lectures: 30 h

Homework: 30 h

Exam Preparation: 20 h

M 2.126 Module: Theory of Turbulent Flows without and with Superimposed Combustion [M-CIWVT-103074]

Responsible: Prof. Dr.-Ing. Nikolaos Zarzalis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Combustion Technology

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-106108	Theory of Turbulent Flows without and with Superimposed Combustion	4 CR	

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal

- The students understand the similarity between momentum, heat and mass transfer.
- The students are able, based on the analogy between laminar and turbulent transport, to explain and quantify the "turbulent" diffusion.
- The students are able to evaluate measured distribution of turbulent parameters.
- Based on the turbulence and heat release interaction the students are able to evaluate experimental results of turbulent flames.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Turbulence characterization; Derivation of the balance equations for mass, momentum and energy; Turbulent momentum, heat and mass transport; Derivation of the balance equation for the kinetic energy of the mean and fluctuating flow field; Derivation of the balance equation for enstrophy of the mean and fluctuating flow field; The turbulent energy cascade process; The interaction between turbulence and heat release by turbulent premixed flames.

Workload

- Attendance time (Lecture): 30 h
- Homework: 15 h
- Exam Preparation: 75 h

Literature
Tennekes and Lumley, A first course in turbulence; N. Peters, Turbulent combustion; T. Poinsot, D. Veynante, Theoretical and numerical combustion

M 2.127 Module: Thermal Separation Processes II [M-CIWVT-104365]

Responsible: Prof. Dr.-Ing. Matthias Kind
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108926	Thermal Separation Processes II	6 CR	Kind

Competence Certificate
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Acquisition of deep understanding of chemical engineering processes using the example of continuous distillation of multi-component mixtures. Ability to transfer this understanding into a numerical model and solving this model. Understanding of column fluid dynamics.

Prerequisites
None

Content
Fundamentals of modelling and simlation of chemical engineering processes using the example of distillation of multi-component mixtures: phase equilibrium, fugacity coefficient, models for activity coefficient, flash, MESH-equations for continuous distillation, solution method of Thiele and Gaddes, introduction to advanced numerical methods, fundamentals of fluid dynamic design considerations of tray and packed columns

Workload

- Attendance time (Lecture): 45 h
- Homework: 70 h
- Exam Preparation: 70 h

Literature

- Gmehling, J.; Kolbe, B.; Kleiber, M.; Rarey, J. R. Chemical thermodynamics; Wiley-VCH, 2012
- Schlünder, E.-U.; Thurner, F. Destillation, Absorption, Extraktion; Lehrbuch Chemie + Technik; Vieweg, 1995
- Stephan, P.; Mayinger, F.; Schaber, K.; Stephan, K. Thermodynamik. Band 2, 15th ed.; Springer, 2010
- VDI-GVC, Ed. VDI-Wärmeatlas, 11., bearb. und erw. Aufl.; VDI-Buch; Springer Vieweg: Berlin, 2013

2.128 Module: Thermal Transport Processes [M-CIWVT-104377]

Responsible: Prof. Dr.-Ing. Matthias Kind
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	5	1

Mandatory			
T-CIWVT-106034	Thermal Transport Processes	6 CR	Kind

Competence Certificate
The examination is a written examination with a duration of 180 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

Competence Goal
Students can systematically apply scientific methods for physics-based modelling of Thermal Transport Processes and of selected unit operations. To this end they are able to create mathematical models and systems of equations for process simulation. Furthermore, they have some know-how to use numerical tools for solving these quite large systems of equations. Finally, students are skilled in the quantitative application of the taught knowledge to new and yet unknown processes and engineering problems.

Prerequisites
None

Content
Fundamentals of process simulation with specific regard to Thermal Transport Processes. Advanced Heat and Mass Transfer (boiling, condensation, multi-component mass transport).

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

Literature

- comprehensive manuscript (for download)
- pertinent list of literature for self-studying

M 2.129 Module: Thermo- and Particle Dynamics of Particular Systems [M-CIWVT-104363]

Responsible: Prof. Dr.-Ing. Michael Türk
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
6	Each summer term	German	4	1

Mandatory			
T-CIWVT-108924	Thermo- and Particle Dynamics of Particular Systems	6 CR	Türk

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

Literature

- Friedlander, S.K.F.: Smoke, Dust and Haze – Fundamentals of Aerosol Dynamics, (2nd Ed.) Oxford Univ. Press, New York Oxford 2000
- Debenedetti, P.G. : Metastable Liquids - Concepts and Principles, Princeton Univ. Press, Princeton, New Jersey 1996

M 2.130 Module: Thermodynamics III [M-CIWVT-103058]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	5	1

Mandatory			
T-CIWVT-106033	Thermodynamics III	6 CR	Enders

Competence Certificate
The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

Competence Goal
Students are familiar with the basic principles for the description of complex, multicomponent mixtures and thermodynamic equilibria including equilibria with chemical reactions. They are able to select suitable models and to calculate the properties of multicomponent real systems.

Prerequisites
None

Content
Phase- and reaction equilibria of real systems, equations of state for real mixtures, models for activity coefficients, polymer solutions, protein solutions, elektrolyte solutions.

Workload

- Attendance time (Lecture): 60 h
- Homework: 90 h
- Exam Preparation: 30 h

Literature
1. Stephan, P., Schaber, K., Stephan, K., Mayinger, F.: Thermodynamik, Band 2, 15. Auflage, Springer Verlag, 2010.
2. Sandler, S. I.: Chemical, Biochemical and Engineering Thermodynamics, J. Wiley & Sons, 2008.
3. Gmehling, J, Kolbe, B., Kleiber, M., Rarey, J.: Chemical Thermodynamics for Process Simulations, Wiley-VCG Verlag, 2012

M 2.131 Module: Thermodynamics of Interfaces [M-CIWVT-103063]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
4	Each summer term	German	4	1

Mandatory			
T-CIWVT-106100	Thermodynamics of Interfaces	4 CR	Enders

Competence Goal
The students to be familiar with the peculiarities on fluid-fluid and fluid-solid interfacial properties. They are able to calculate interfacial properties (interfacial tension, density - and concentration profils, adsorption isotherms) using macroscopic and local-dependent methods.

Prerequisites
None

Content
Gibbs-method, density functional theory, experimental methods for characterization of interfaces, adsorption

M 2.132 Module: Thermodynamics of Phase Equilibria [M-CIWVT-104360]

Responsible: Prof. Dr.-Ing. Michael Türk
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics
Specialized Course I / Technical Biology

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108921	Thermodynamics of Phase Equilibria	6 CR	Türk

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Workload
- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

Literature
Ulrich K. Deiters and Thomas Kraska; 2012, „High-Pressure Fluid Phase Equilibria“, 1st Edition, Phenomenology and Computation, Elsevier, ISBN: 978-0-444-56347-7

John M. Prausnitz, Ruediger N. Lichtenthaler, Edmundo Gomes de Azevedo; 1999, „Molecular Thermodynamics of Fluid-Phase Equilibria“ (3rd Edition) ISBN: 0-13-977745-8

B. Poling, J.M. Prausnitz, J.P. O'Connell; 2001 „Properties of Gases and Liquids, 5th Ed.", McGraw-Hill Book Company, ISBN 0-07-011682-2

M 2.133 Module: Transport and Storage of Chemical Energy Carriers [M-CIWVT-105406]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2020)
Specialized Course I / Energy and Combustion Technology (Usage from 4/1/2020)

Credits	Recurrence	Language	Level	Version
4	Each summer term	English	5	1

Mandatory			
T-CIWVT-110916	Transport and Storage of Chemical Energy Carriers	4 CR	Kolb

Competence Certificate
Learning control is an oral examination with a duration of about 25 minutes according to SPO section 4 subsection 2.

Competence Goal
Application of basic principles of engineering on the special problems of a municipal utility company.

Module grade calculation
The module grade ist the grade of oral examination.

Content
The master course "Transport and Storage of Chemical Energy Carriers" teaches the fundamentals of two important steps of today's energy supply chain: transportation and storage. The transportation of chemical energy carriers from the source to the consumer is discussed in detail and options for storage are presented. The lecture also teaches the basics of organization and management of utilities companies and the basics of economics (profitability analysis, cost estimation). Lecturers are renowned experts from industry and research.

- Energy Resources / Chemical Energy Carriers
- Distribution Systems
- Natural Gas Utilization
- Organisation and Management Systems
- Fundamentals of Economics
- Profitability Analysis
- Conversion Processes
- Odorants and Odorization
- Gas Appliances and New Technologies
- Production, Upgrading and Injection of Gases from RES
- Estimating the Capital Expenditure of Chemical Plants

Workload
Total 120 h:

- lectures: 30 h
- homework: 60 h
- exam preparation: 30 h

M 2.134 Module: Unit Operations and Process Chains for Food of Animal Origin [M-CIWVT-104421]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Product Design
Specialized Course I / Food Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
4	Each winter term	German	4	2

Mandatory			
T-CIWVT-108996	Unit Operations and Process Chains for Food of Animal Origin	4 CR	Karbstein

Competence Certificate
Learning control is an oral examination with a duration about of 15 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students understand and are able to explain conventional methods for producing foods, even complex ones, from animals. They know process chains and unit operations of relevance, both conventional and innovative approaches. They are able to design the processes according to raw material specifics. They identify correlations between process parameters and quality-determining properties of food. They are also able to transfer process knowledge between individual product groups. They know essential aspects required to assess sustainability and energy aspects of the individual process steps and complete process chains.

Students are able to apply principles of product design. This involves identifying the relationships between process parameters and the structure of a food product (process function) as well as between the inner structure of foods and their properties (property function). Based on this, they are able to analyze and solve problems in the field of food process engineering.

Students are able to use their knowledge to evaluate a process unit with regard to food production, involving aspects such as sustainability, energy efficiency, food safety or expected product quality.

Module grade calculation
Grade of the module is the grade of oral examination.

Prerequisites
None

Content
Lecture: Milk and dairy products, meat and meat products, sausages, functional foods: Process chains and unit operations

Basics of process design, process energy and raw material related specifics, innovative processes; relevant parameters for keeping food safety and quality.

Workload
Lectures: 30 h

Homework: 60 h

Exam preparation: 30 h

Literature
Vorlesungsfolien (KIT ILIAS Studierendenportal)

H.P. Schuchmann und H. Schuchmann: Lebensmittelverfahrenstechnik: Rohstoffe, Prozesse, Produkte; Wiley VCH, 2005; ISBN: 978-3-527-66054-4 (auch als ebook)

H.G. Kessler: Lebensmittel- und Bioverfahrenstechnik – Molkereitechnologie, Verlag A. Kessler, 1996, ISBN 3-9802378-4-2

H.G. Kessler: Food and Bio Process Engineering - Dairy Technology, Publishing House A. Kessler, 2002, ISBN 3-9802378-5-0

M. Loncin: Die Grundlagen der Verfahrenstechnik in der Lebensmittelindustrie; Aarau Verlag, 1969, ISBN 978-3794107209

M 2.135 Module: Unit Operations and Process Chains for Food of Plant Origin [M-CIWVT-104420]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Product Design
Specialized Course I / Food Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108995	Unit Operations and Process Chains for Food of Plant Origin	6 CR	Karbstein

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Students understand and are able to explain conventional methods for producing foods, even complex ones, from plants. They know process chains and unit operations of relevance, both conventional and innovative approaches. They are able to design the processes according to raw material specifics. They identify correlations between process parameters and quality-determining properties of food. They are also able to transfer process knowledge between individual product groups. They know essential aspects required to assess sustainability and energy aspects of the individual process steps and complete process chains.

Students are able to apply principles of product design. This involves identifying the relationships between process parameters and the structure of a food product (process function) as well as between the inner structure of foods and their properties (property function). Based on this, they are able to analyze and solve problems in the field of food process engineering.

Students are able to use their knowledge to evaluate a process unit with regard to food production, involving aspects such as sustainability, energy efficiency, food safety or expected product quality.

Prerequisites
None

Content
Food oils and fats, margarines and spreadable fats, cereals, fruits and vegetables, sugar, chocolate, coffee, bear, wine, spirits: Process chains and unit operations: Basics of process design, process energy and raw material related specifics, innovative processes; relevant parameters for keeping food safety and quality.

Workload
- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

Literature
Vorlesungsfolien (KIT ILIAS Studierendenportal)

H.P. Schuchmann und H. Schuchmann: Lebensmittelverfahrenstechnik: Rohstoffe, Prozesse, Produkte; Wiley VCH, 2005; ISBN: 978-3-527-66054-4 (auch als ebook)

H.G. Kessler: Lebensmittel- und Bioverfahrenstechnik – Molkereitechnologie, Verlag A. Kessler, 1996, ISBN 3-9802378-4-2

H.G. Kessler: Food and Bio Process Engineering - Dairy Technology, Publishing House A. Kessler, 2002, ISBN 3-9802378-5-0

M. Loncin: Die Grundlagen der Verfahrenstechnik in der Lebensmittelindustrie; Aarau Verlag, 1969, ISBN 978-3794107209

M 2.136 Module: Vacuum Technology [M-CIWVT-104478]

Responsible: Dr. Christian Day
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-109154	Vacuum Technology	6 CR	Day

Competence Certificate
The examination is an oral examination with a duration of 20 about minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Competence Goal
Students will be able to explain basic physical relationships in vacuum science. Building on this, they can design a complex vacuum system correctly and in accordance with specifications.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Basics; vacuum pumps; practical vacuum limits; outgassing and its minimization; cleanliness requirements; vacuum instrumentation; total pressure measurement; residual gas analysis; leak detection; rarefied gas flow; design of vacuum systems; technical specifications; quality in vacuum; examples for large vacuum systems; industrial applications in the process industry.

Workload

- Attendance time (Lecture): 60 h
- Homework: 80 h
- Exam Preparation: 40 h

Learning type
22033 – Übung zu Vakuumtechnik

22034 – Vakuumtechnik

Literature
K. Jousten (Ed.) - Wutz Handbuch Vakuumtechnik, 11. Auflage, Springer, 2013.

M 2.137 Module: Wastewater Treatment Technologies (bauiM2S43-SW10) [M-BGU-104917]

Responsible: Dr.-Ing. Tobias Morck
Organisation: KIT Department of Civil Engineering, Geo- and Environmental Sciences
Part of: Technical Supplement Course (Usage from 4/1/2019)
Specialized Course I / Environmental Process Engineering (Usage from 4/1/2019)
Specialized Course I / Water Technology (Usage from 4/1/2019)

Credits	Recurrence	Language	Level	Version
6	Each winter term	English	4	1

Mandatory			
T-BGU-109265	Term Paper 'International Sanitary Engineering'	1 CR	Fuchs, Morck
T-BGU-109948	Wastewater Treatment Technologies	5 CR	Fuchs, Morck

Competence Certificate
- 'Teilleistung' T-BGU-109265 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-109948 with written examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective 'Teilleistung'

Competence Goal
Students acquire knowledge about typical techniques in wastewater treatment at local and international level. They are able to perform a technical evaluation and describe dimensioning approaches taking into consideration legal boundary conditions. Students analyze, evaluate and optimize operation of plant technologies. They focus on energy-efficient plant designs considering the most relevant factors affecting the total costs.Students can analyze the situation in emerging and developing countries making a comparison with that in industrialized countries. Based on that, they are able to develop water-related management strategies.

Module grade calculation
grade of the module is grade of the exam

Prerequisites
none

Content
Municipal Wastewater Treatment:

Students gain deep knowledge about design and operation of typical process technologies in municipal wastewater treatment in Germany. Following processes are covered:

- different activated sludge processes
- anaerobic technologies and energy-recovery systems
- filtration technologies
- wastewater disinfection and pathogen removal
- chemical and biological phosphorus removal
- micro-pollutants removal
- resource management and energy efficiency

International Sanitary Engineering:

Students get acquainted with the design and operation used for wastewater treatment at international level. They analyze, evaluate and take decisions when new and more holistic oriented met hods can be implemented. Following topics are covered:

- activated sludge processes
- trickling filters and rotating biological contactors
- treatment ponds
- retention soil filter / Wetlands
- UASB/EGSB/Anaerobic filter
- decentralized versus centralized systems
- material flow separation
- energy-recovery from wastewater
- drinking water purification
- waste management

Recommendation
module 'Urban Water Infrastructure and Management'

Annotation
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- Municipal Wastewater Treatment lecture/exercise: 30 h
- International Sanitary Engineering lecture/exercise: 30 h

independent study:

- preparation and follow-up lecture/exercises Municipal Wastewater Treatment: 30 h
- preparation of Term paper 'International Sanitary Engineering' (exam prerequisite): 45 h
- examination preparation: 45 h

total: 180 h

Literature
Imhoff, K. u. K.R. (1999) Taschenbuch der Stadtentwässerung, 29. Aufl., Oldenbourg Verlag, München, Wien
ATV-DVWK (1997) Handbuch der Abwassertechnik: Biologische und weitergehende Abwasserreinigung, Band 5, Verlag Ernst & Sohn, Berlin
ATV-DVWK(1997) Handbuch der Abwassertechnik: Mechanische Abwasserreinigung, Band 6, Verlag Ernst & Sohn , Berlin
Sperling, M.; Chernicaro, C.A.L. (2005) Biological wastewater treatment in warm climate regions, IWA publishing, London
Wilderer, P.A., Schroeder, E.D. and Kopp, H. (2004) Global Sustainability - The Impact of Local Cultures. A New Perspective for Science and Engineering, Economics and Politics WILEY-VCH

M 2.138 Module: Water Quality Assessment [M-CIWVT-104301]

Responsible: Dr. Gudrun Abbt-Braun
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Water Technology

Credits	Recurrence	Language	Level	Version
6	Each winter term	German	4	1

Mandatory			
T-CIWVT-108841	Water Quality Assessment	6 CR	Abbt-Braun

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
Students can explain links between the geogenic and anthropogenic occurrence and the concentration of organic and inorganic compounds in the hydrological cycle. They get knowledge about the analysis of the water constituents and of microorganism in the water samples. They are able to do calculations, and to compare and interpret data. They will learn how to use different methods, and to interpret water quality assessment.

Module grade calculation
The grade of the oral examination is the module grade.

Prerequisites
None

Content
Various types of water, legislation, analytical definitions, sampling methods, quick test methods, field investigations, organoleptic determinations, general investigations, optical characterization (turbidity, color, UV, Lambert-Beer`s law, photometry), titrations, acid-base-systems, buffering, main inorganic compounds (anions, cations, occurrence, ion chromatography, titration, complexometry, flame photometry, atomic spectroscopy), heavy metals and metalloids (occurrence and main methods for determination), organic compounds and organic micropollutants (occurrence, liquid chromatography, infrared spectroscopy, gas chromatography), water specific sum parameters (DOC, AOX, AOS, CSB, BSB), microbiology.

Workload

- Attendance time (Lecture): 45 h
- Homework: 65 h
- Exam Preparation: 70 h

Literature

- Harris, D. C. (2010): Quantitative Chemical Analysis. W. H. Freeman and Company, New York.
- Crittenden J. C. et al. (2005): Water Treatment – Principles and Design, Wiley & Sons, Hoboken.
- Patnaik P. (2010), Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil, and Solid Wastes. CRC Press.
- Wilderer, P. (2011). Treatise on Water Science, Four-Volume Set, 1st Edition; Volume 3: Aquatic Chemistry and Biology. Elsevier,Oxford.
- Vorlesungsunterlagen im ILIAS

M 2.139 Module: Water Technology [M-CIWVT-103407]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Environmental Process Engineering
Specialized Course I / Food Process Engineering
Specialized Course I / Water Technology

Credits	Recurrence	Language	Level	Version
6	Each winter term	English	4	1

Mandatory			
T-CIWVT-106802	Water Technology	6 CR	Horn

Competence Certificate
Oral exam, 30 min

Competence Goal
Students learn fundamental knowledge in water chemistry and how to apply it to processes in aquatic systems in general and in reactors for water treatment. Water treatment will be taught for drinking water and partly waste water. The students are able to apply physical, chemical and biochemical treatment for the respective removal of particulate and dissolved components in water. They are able to use the fundamental design parameters for the different types of unit operations.

Prerequisites
None

Content
Water cycle, different types of raw water (ground and surface water). Water as solvent, carbonate balance, differentiation between microbiological and chemical population. Unit operations: sieving, sedimentation, filtration, flocculation, flotation, ion exchange, aeration, oxidation, disinfection, adsorption). For all unit operations design parameters will be provided. Simple 1D models will be discussed for description of kinetics and retention time in reactors for water treatment.

Workload
Attendance time: 45 h
Preparation/follow-up: 60 h
Examination + exam preparation: 75 h

Literature
Crittenden, J.C. et al., 2005. Water treatment – Principles and design. Wiley & Sons, Hoboken.

Jekel, M., Gimbel, R., Ließfeld, R., 2004. DVGW-Handbuch: Wasseraufbereitung – Grundlagen und Verfahren. Oldenbourg, München.

Lecture notes will be provided in ILIAS

3 Courses

T 3.1 Course: Additive Manufacturing for Process Engineering - Examination [T-CIWVT-110902]

Responsible: Prof. Dr.-Ing. Roland Dittmeyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105407 - Additive Manufacturing for Process Engineering

Type	Credits	Recurrence	Version
Oral examination	5	Each summer term	1

Events					
SS 2020	22103	Additive manufacturing for process engineering	2 SWS	Lecture (V)	Dittmeyer, Ladewig, Navarrete Munoz

Competence Certificate
Oral examination with a duration of about 30 minutes.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-110903 - Practical in Additive Manufacturing for Process Engineering must have been passed.

T 3.2 Course: Applied Combustion Technology [T-CIWVT-110540]

Responsible: Dr. Peter Habisreuther
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105201 - Applied Combustion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2020	22528	Applied Combustion Technology (ENTECH)	2 SWS	Lecture (V)	Habisreuther

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.3 Course: Applied Combustion Technology [T-CIWVT-108839]

Responsible: Prof. Dr.-Ing. Nikolaos Zarzalis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104299 - Applied Combustion Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22503	Applied combustion technology	2 SWS	Lecture (V)	Zarzalis
WS 19/20	22504	Exercises for 22503 Applied combustion technology	1 SWS	Practice (Ü)	Zarzalis, und Mitarbeiter

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.4 Course: Applied Molecular Thermodynamics [T-CIWVT-108922]

Responsible: Prof. Dr.-Ing. Michael Türk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104361 - Applied Molecular Thermodynamics

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22019	Angewandte Molekulare Thermodynamik	3 SWS	Lecture / Practice (VÜ)	Türk

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.5 Course: Biobased Plastics [T-CIWVT-109369]

Responsible: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104570 - Biobased Plastics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22414	Biobased Plastic	2 SWS	Lecture (V)	Kindervater, Syldatk, Schmiedl

Competence Certificate
Verteifungsfach:

The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Technisches Ergänzungsfach or a large number of aatudents:

The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).

Prerequisites
None

T 3.6 Course: Bioelectrochemistry and Biosensors [T-CIWVT-108807]

Responsible: Dr. Michael Wörner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104268 - Bioelectrochemistry and Biosensors

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22708	Bioelectrochemistry and Biosensors	2 SWS	Lecture (V)	Wörner

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.7 Course: Biofilm Systems [T-CIWVT-106841]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103441 - Biofilm Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22617	Biofilm Systems	2 SWS	Lecture (V)	Horn, Gescher, Hille-Reichel, Wagner

Competence Certificate
Oral exam, about 20 min.

T 3.8 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I [T-MACH-100966]

Responsible: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-100489 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine I

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2141864	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	2 SWS	Lecture (V)	Guber

Competence Certificate
written exam (75 Min.)

Prerequisites
none

T 3.9 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II [T-MACH-100967]

Responsible: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-100490 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine II

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2020	2142883	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	2 SWS	Lecture (V)	Guber

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

T 3.10 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III [T-MACH-100968]

Responsible: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-100491 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine III

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2020	2142879	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	2 SWS	Lecture (V)	Guber

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

T 3.11 Course: Biomimetic Interfaces and Bioconjugation [T-CIWVT-108810]

Responsible: Dr. Michael Wörner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104272 - Biomimetic Interfaces and Bioconjugation

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22716	Biomimetic Interfaces and Bioconjugation	2 SWS	Lecture (V)	Wörner

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.12 Course: Biopharmaceutical Purification Processes [T-CIWVT-106029]

Responsible: Prof. Dr.-Ing. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103065 - Biopharmaceutical Purification Processes

Type	Credits	Version
Written examination	6	1

Events					
WS 19/20	22705	Biopharmaceutical Pruification Processes	3 SWS	Lecture (V)	Hubbuch, Franzreb
WS 19/20	22706	Exercises on Biopharmaceutical Pruification Processes (22705)	1 SWS	Practice (Ü)	Hubbuch, Franzreb

Competence Certificate
The examination is a written examination with a duration of 120 minutes (section 4 subsection 2 number 1 SPO).

3.13 Course: Bioprocess Development [T-CIWVT-108902]

Responsible: Michael-Helmut Kopf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104347 - Bioprocess Development

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22933	Bioprocess Development	2 SWS	Lecture (V)	Kopf

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.14 Course: Biotechnological Production [T-CIWVT-106030]

Responsible: Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104384 - Biotechnological Production

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	2

Events					
SS 2020	22409	Übung zu 22410 Biotechnologische Stoffproduktion	2 SWS	Practice (Ü)	Syldatk
SS 2020	22410	Biotechnical Production Methods	2 SWS	Lecture (V)	Syldatk

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-108492 - Seminar Biotechnological Production must have been passed.

T 3.15 Course: Biotechnology in Bioeconomy [T-CIWVT-108982]

Responsible: Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104399 - Biotechnology in Bioeconomy
M-CIWVT-105295 - Biotechnological Use of Renewable Resources

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	22401	Biotechnologische Prozesse in der Bioökonomie - Vertiefungsfach	2 SWS	Lecture (V)	Syldatk

Competence Certificate
The examination is an oral examination with a duration ob about 25 Minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.16 Course: Biotechnology in Bioeconomy -Seminar [T-CIWVT-110770]

Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104399 - Biotechnology in Bioeconomy

Type	Credits	Recurrence	Version
Completed coursework	2	Each winter term	1

Events					
WS 19/20	22401	Biotechnologische Prozesse in der Bioökonomie - Vertiefungsfach	2 SWS	Lecture (V)	Syldatk

Competence Certificate
The examination is an oral examination with a duration (section 4 subsection 3 SPO).

Prerequisites
None

T 3.17 Course: Catalytic Micro Reactors [T-CIWVT-109087]

Responsible: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104451 - Catalytic Micro Reactors
M-CIWVT-104491 - Catalytic Micro Reactors (including practical course)

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22136	Katalytische Mikroreaktoren	2 SWS	Lecture (V)	Pfeifer
SS 2020	22137	Praktikum zu 22136 Katalytische Mikroreaktoren	1 SWS	Practical course (P)	Pfeifer, Dittmeyer, und Mitarbeiter

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.18 Course: Catalytic Processes in Gas Technologies [T-CIWVT-108827]

Responsible: Dr.-Ing. Siegfried Bajohr
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104287 - Catalytic Processes in Gas Technologies

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22345	Katalytische Verfahren der Gastechnik	2 SWS	Lecture (V)	Bajohr

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.19 Course: Chemical Fuels [T-CIWVT-110307]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105200 - Liquid Transportation Fuels

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	2

Events					
SS 2020	22331	Chemical Fuels (ENTECH)	2 SWS	Lecture (V)	Rauch

Competence Certificate
Learning Control is an oral examination with a duration of about 20 minutes.

Prerequisites
None

T 3.20 Course: Chemical Process Engineering II [T-CIWVT-108817]

Responsible: Prof. Dr. Bettina Kraushaar-Czarnetzki
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104281 - Chemical Process Engineering II

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22122	Chemische Verfahrenstechnik II	2 SWS	Lecture (V)	Kraushaar-Czarnetzki

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.21 Course: Chem-Plant [T-CIWVT-109127]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104461 - Chem-Plant

Type	Credits	Recurrence	Version
Examination of another type	4	Each summer term	1

Prerequisites
None

Recommendation
Thermodynamics III, Process Technology

T 3.22 Course: Combustion and Environment [T-CIWVT-108835]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104295 - Combustion and Environment

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22507	Verbrennung und Umwelt	2 SWS	Lecture (V)	Trimis

Prerequisites
None

3.23 Course: Combustion Technology [T-CIWVT-106104]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103069 - Combustion Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22501	Fundamentals of combustion technology	2 SWS	Lecture (V)	Trimis
WS 19/20	22502	Exercises for 22501 Fundamentals of combustion technology	1 SWS	Practice (Ü)	Trimis, und Mitarbeiter

Prerequisites
None

T 3.24 Course: Commercial Biotechnology [T-CIWVT-108811]

Responsible: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104273 - Commercial Biotechnology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22413	Commercial Biotechnology	2 SWS	Lecture (V)	Kindervater, Otto, Mühlenbeck, Ulrich, Witter, Lehmann

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

In case of large number of participants the examination is a written examination with a duration of 60 minutes (section 4 subsection 2 number 1 SPO).

Prerequisites
None

T 3.25 Course: Computational Fluid Dynamics [T-CIWVT-106035]

Responsible: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103072 - Computational Fluid Dynamics

Type	Credits	Recurrence	Version
Written examination	6	Each term	1

Events					
WS 19/20	22958	Computational Fluid Dynamics	2 SWS	Lecture / Practice (VÜ)	Nirschl, und Mitarbeiter
WS 19/20	22959	Übungen zu 22958 Numerische Strömungssimulation (in kleinen Gruppen)	1 SWS	Practice (Ü)	Nirschl, und Mitarbeiter

T 3.26 Course: Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids [T-CIWVT-108883]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104328 - Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22962		2 SWS	Lecture (V)	Hochstein

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.27 Course: Cryogenic Engineering [T-CIWVT-108915]

Responsible: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104356 - Cryogenic Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22053	Cryogenic Engineering	2 SWS	Lecture (V)	Grohmann
WS 19/20	22054	Cryogenic Engineering - Exercises	1 SWS	Practice (Ü)	Grohmann

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.28 Course: Data Analysis and Statistics [T-CIWVT-108900]

Responsible: Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104345 - Data Analysis and Statistics

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22943	Data Analysis and Statistics	2 SWS	Lecture (V)	Guthausen

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.29 Course: Design of a Jet Engine Combustion Chamber [T-CIWVT-110571]

Responsible: Prof. Dr.-Ing. Nikolaos Zarzalis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105206 - Design of a Jet Engine Combustion Chamber

Type	Credits	Recurrence	Version
Examination of another type	6	Each winter term	1

Events					
WS 19/20	22527	Design of a Jet Engine Combustion Chamber	SWS		Zarzalis

Competence Certificate
Success control is an examination of another kind according to § 4 Abs. 2 Nr. 3 SPO.

Project: Participation and presentation as well as a final oral examination amounting to max. 30 minutes.

Prerequisites
None

T 3.30 Course: Design of Micro Reactors [T-CIWVT-108826]

Responsible: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104286 - Design of Micro Reactors

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22145	Auslegung von Mikroreaktoren	4 SWS	Lecture / Practice (VÜ)	Pfeifer

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4, subsection 2, number 2 SPO).

Prerequisites
None

T 3.31 Course: Development of an Innovative Food Product [T-CIWVT-108960]

Responsible: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104388 - Development of an Innovative Food Product

Type	Credits	Recurrence	Version
Examination of another type	6	Each winter term	1

Events					
SS 2020	22234	Teamprojekt "Eco TROPHELIA": Entwicklung eines innovativen Lebensmittels	3 SWS	Project (PRO)	Karbstein, van der Schaaf, und Mitarbeiter

Competence Certificate
Success control is an examination of another kind:

- an oral exam (colloquium) of about 20 minutes
- a written elaboration

Prerequisites
None

T 3.32 Course: Digitization in particle technology [T-CIWVT-110111]

Responsible: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104973 - Digitization in particle technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22957	Digitization in Particle Technology	2 SWS	Lecture (V)	Nirschl, und Mitarbeiter

Competence Certificate
Learning Control is an oral examination with a duration of 30 minutes.

Prerequisites
None

T 3.33 Course: Dimensional Analysis of Fluid Mechanic Problems [T-CIWVT-108882]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104327 - Dimensional Analysis of Fluid Mechanic Problems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22927	Dimensionsanalyse strömungsmechanischer Fragestellungen	2 SWS	Lecture (V)	Hochstein

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.34 Course: Drying Technology [T-CIWVT-108936]

Responsible: Prof. Dr.-Ing. Wilhelm Schabel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104370 - Drying Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22811	Drying Technology	2 SWS	Lecture (V)	Schabel
WS 19/20	22821	Übung zu 22811 Trocknungstechnik	1 SWS	Practice (Ü)	Schabel, und Mitarbeiter

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.35 Course: Economic Evaluation of Capital Projects [T-CIWVT-108962]

Responsible: Prof. Dr.-Ing. Dieter Stapf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104390 - Economic Evaluation of Capital Projects

Type	Credits	Recurrence	Version
Oral examination	2	Each winter term	1

Events					
WS 19/20	22553	Economic evaluation of capital projects	1 SWS	Block (B)	Stapf, und Mitarbeiter

Competence Certificate
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.36 Course: Energy and Environment [T-CIWVT-109089]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Prof. Dr.-Ing. Dimosthenis Trimis

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-104453 - Energy and Environment

Type	Credits	Recurrence	Version
Oral examination	8	Each term	1

Events					
WS 19/20	22516	Technical Systems for Thermal Waste Treatment	2 SWS	Lecture (V)	Kolb
SS 2020	22507	Verbrennung und Umwelt	2 SWS	Lecture (V)	Trimis

Prerequisites
None

T 3.37 Course: Energy and Environment [T-CIWVT-110917]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Prof. Dr.-Ing. Dimosthenis Trimis

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-104453 - Energy and Environment

Type	Credits	Recurrence	Version
Oral examination	8	Each term	1

Events					
SS 2020	22528	Applied Combustion Technology (ENTECH)	2 SWS	Lecture (V)	Habisreuther

Prerequisites
None

T 3.38 Course: Energy from Biomass [T-CIWVT-108828]

Responsible: Dr.-Ing. Siegfried Bajohr
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104288 - Biomass Based Energy Carriers

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22320	Energieträger aus Biomasse	2 SWS	Lecture (V)	Bajohr
WS 19/20	22321	Übung zu Energieträger aus Biomasse (22320)	1 SWS	Practice (Ü)	Bajohr, und Mitarbeiter

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.39 Course: Energy from Biomass [T-CIWVT-110576]

Responsible: Dr.-Ing. Siegfried Bajohr
Prof. Dr. Nicolaus Dahmen

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-105207 - Energy from Biomass

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	2

Events					
WS 19/20	22325	Energy from Biomass	2 SWS	Lecture (V)	Dahmen, Bajohr

Competence Certificate
The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).

Prerequisites
None

T 3.40 Course: Energy Technology [T-CIWVT-108833]

Responsible: Prof. Dr. Horst Büchner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104293 - Energy Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22511	Energy technology I	2 SWS	Lecture (V)	Büchner

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.41 Course: Environmental Biotechnology [T-CIWVT-106835]

Responsible: Andreas Tiehm
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104320 - Environmental Biotechnology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	22614	Environmental Biotechnology	2 SWS	Lecture (V)	Tiehm

Prerequisites
None

T 3.42 Course: Excursions: Membrane Technologies [T-CIWVT-110864]

Responsible: Prof. Dr. Harald Horn
Dr.-Ing. Florencia Saravia

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-105380 - Membrane Technologies in Water Treatment

Type	Credits	Recurrence	Version
Completed coursework	1	Each summer term	1

Events					
SS 2020	22606	Practical in Membrane Technologies in Water Treatment	1 SWS	Practice (Ü)	Horn, Saravia, und Mitarbeiter

T 3.43 Course: Excursions: Water Supply [T-CIWVT-110866]

Responsible: Dr. Gudrun Abbt-Braun
Prof. Dr. Harald Horn

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-103440 - Practical Course in Water Technology

Type	Credits	Recurrence	Version
Completed coursework	1	Each winter term	1

T 3.44 Course: Flow and Combustion Instabilities in Technical Burner Systems [T-CIWVT-108834]

Responsible: Prof. Dr. Horst Büchner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104294 - Flow and Combustion Instabilities in Technical Burner Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22515	Strömungs- und Verbrennungsinstabilitäten in technischen Feuerungssystemen	2 SWS		Büchner

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.45 Course: Fluid Mechanics of Non-Newtonian Fluids [T-CIWVT-108874]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104322 - Fluid Mechanics of Non Newtonian Fluids

Type	Credits	Recurrence	Version
Oral examination	8	Each term	1

Events					
WS 19/20	22962		2 SWS	Lecture (V)	Hochstein
SS 2020	22927	Dimensionsanalyse strömungsmechanischer Fragestellungen	2 SWS	Lecture (V)	Hochstein

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.46 Course: Fluidized Bed Technology [T-CIWVT-108832]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104292 - Fluidized Bed Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
SS 2020	22303	Fluidized bed technology	2 SWS	Lecture (V)	Rauch

Competence Certificate
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.47 Course: Food Chemistry Basics [T-CHEMBIO-109442]

Responsible: Prof. Dr. Mirko Bunzel
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-104620 - Food Chemistry Basics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Prerequisites
None

T 3.48 Course: Food Science and Functionality [T-CIWVT-108801]

Responsible: Prof. Dr. Bernhard Watzl
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104263 - Food Science and Functionality

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22207	Lebensmittelkunde und -funktionalität	2 SWS	Lecture (V)	Watzl

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.49 Course: Formulation of (Bio)pharmaceutical Therapeutics [T-CIWVT-108805]

Responsible: Prof. Dr.-Ing. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104266 - Formulation of (Bio)pharmaceutical Therapeutics

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22712	Formulation of (Bio)pharmaceutical Therapeutics	2 SWS	Lecture (V)	Hubbuch

Competence Certificate
The examination is an oral examination with a duration of about 15 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.50 Course: Formulation Processes for Life Sciences [T-CIWVT-108985]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104402 - Formulation Processes for Life Sciences

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22209		1 SWS	Lecture (V)	van der Schaaf
WS 19/20	22226		1 SWS	Lecture (V)	Wittner
WS 19/20	22229		1 SWS	Lecture (V)	Wittner
WS 19/20	22246	Extrusion technology in food processing	1 SWS	Lecture (V)	Emin

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 1 SPO).

Prerequisites
None

T 3.51 Course: Fuel Technology [T-CIWVT-108829]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104289 - Fuel Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22305	Grundlagen der Brennstofftechnik	2 SWS	Lecture (V)	Kolb
WS 19/20	22306	Übungen zu 22305 Grundlagen der Brennstofftechnik	1 SWS	Practice (Ü)	und Mitarbeiter, Kolb

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.52 Course: Fundamentals of Motoric Exhaust Aftertreatment [T-CIWVT-108893]

Responsible: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104338 - Fundamentals of Motoric Exhaust Aftertreatment

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22992	Grundlagen motorischer Abgasnachbehandlung	2 SWS	Lecture (V)	Dittler

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

3.53 Course: Fungal Biotechnology [T-CIWVT-108981]

Responsible: Dr. Katrin Ochsenreither
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104398 - Fungal Biotechnology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22415	Fungal Biotechnology	3 SWS	Block (B)	Ochsenreither

Competence Certificate
Oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-110355 - Fungal Biotechnology - Laboratory must have been passed.

T 3.54 Course: Fungal Biotechnology - Laboratory [T-CIWVT-110355]

Responsible: Dr. Katrin Ochsenreither
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104398 - Fungal Biotechnology

Type	Credits	Version
Completed coursework	2	1

Events					
WS 19/20	22415	Fungal Biotechnology	3 SWS	Block (B)	Ochsenreither

T 3.55 Course: Gas Particle Measurement Technology [T-CIWVT-108892]

Responsible: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104337 - Gas Particle Measurement Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22917	Gas-Partikel-Messtechnik	2 SWS	Lecture (V)	Dittler
WS 19/20	22918	Übungen in kleinen Gruppen zu 22917	1 SWS	Practice (Ü)	Dittler, und Mitarbeiter

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.56 Course: Gas Particle Separation Processes [T-CIWVT-108895]

Responsible: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104340 - Gas Particle Separation Processes

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22939	Gas-Partikel- Trennverfahren	2 SWS	Lecture (V)	Meyer
WS 19/20	22940	Übungen zu 22939 Gas-Partikel-Trennverfahren	1 SWS	Practice (Ü)	Meyer

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (single examination) or 20 minutes (comprehensive examination in VF Gas-Partikel-Systeme) (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.57 Course: Heat Exchangers [T-CIWVT-108937]

Responsible: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104371 - Heat Exchangers

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22807	Wärmeübertrager	2 SWS	Lecture (V)	Wetzel

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.58 Course: Heat Transfer II [T-CIWVT-106067]

Responsible: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103051 - Heat Transfer II

Type	Credits	Version
Oral examination	6	1

Events					
WS 19/20	22809	Wärmeübertragung II	2 SWS	Lecture (V)	Wetzel, Dietrich
WS 19/20	22810	Übungen zu Wärmeübertragung II	1 SWS	Practice (Ü)	Wetzel, Dietrich

T 3.59 Course: Heterogeneous Catalysis II [T-CIWVT-108816]

Responsible: Prof. Dr. Bettina Kraushaar-Czarnetzki
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104280 - Heterogeneous Catalysis II

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22134	Heterogene Katalyse II	2 SWS	Lecture (V)	Kraushaar-Czarnetzki
SS 2020	22135	Repetitorium und Forum zu Heterogene Katalyse II	1 SWS	Practice (Ü)	Kraushaar-Czarnetzki

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.60 Course: High Temperature Process Engineering [T-CIWVT-110912]

Responsible: Prof. Dr.-Ing. Nikolaos Zarzalis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105202 - High Temperature Process Engineering

Type	Credits	Version
Oral examination	4	1

Events					
SS 2020	22533	High Temperature Process Engineering (ENTECH)	2 SWS	Lecture (V)	Stapf

Competence Certificate
Learning control an oral examination with a duration of 30 minutes (section 4 subsection 2 number 2 SPO).

T 3.61 Course: High Temperature Process Engineering [T-CIWVT-106109]

Responsible: Prof. Dr.-Ing. Dieter Stapf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103075 - High Temperature Process Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22505	Hochtemperaturverfahrenstechnik	2 SWS	Lecture (V)	Stapf
SS 2020	22506	Übung zu 22505 Hochtemperaturverfahrenstechnik	1 SWS	Practice (Ü)	Stapf, und Mitarbeiter

Prerequisites
None

T 3.62 Course: Hydrogen and Fuel Cell Technologies [T-CIWVT-108836]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104296 - Hydrogen and Fuel Cell Technologies

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22508	Wasserstoff- und Brennstoffzellentechnologien	2 SWS	Lecture (V)	Trimis

Prerequisites
None

T 3.63 Course: Industrial Aspects in Bioprocess Technology [T-CIWVT-110935]

Responsible: Prof. Dr.-Ing. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105412 - Industrial Aspects in Bioprocess Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Competence Certificate
The examination is an oral examination with a duration of about 15 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.64 Course: Industrial Biocatalysis [T-CIWVT-108813]

Responsible: Dr. Jens Rudat
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104275 - Industrial Biocatalysis

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22411	Industrial Biocatalysis	2 SWS	Lecture (V)	Rudat
WS 19/20	22446	Seminar zu Industrielle Biokatalyse (22411)	1 SWS	Seminar (S)	Rudat

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.65 Course: Industrial Crystallization [T-CIWVT-108925]

Responsible: Prof. Dr.-Ing. Matthias Kind
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104364 - Industrial Crystallization

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22814	Industrielle Kristallisation	2 SWS	Lecture (V)	Kind
SS 2020	22815	Übung zu 22814 Industrielle Kristallisation	1 SWS	Practice (Ü)	Kind

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.66 Course: Industrial Genetics [T-CIWVT-108812]

Responsible: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104274 - Industrial Genetics

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22412	Industrial Genetics	2 SWS	Lecture (V)	Neumann
SS 2020	22447	Seminar zu Methoden der Industriellen Genetik (22412)	1 SWS	Seminar (S)	Neumann

Prerequisites
None

T 3.67 Course: Initial Exam Process Technology and Plant Design [T-CIWVT-106149]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104374 - Process Technology

Type	Credits	Recurrence	Version
Completed coursework (written)	0	Each winter term	1

Events					
WS 19/20	22301	Prozess- und Anlagentechnik I, Grundlagen der Ingenieurstechnik	2 SWS	Lecture (V)	Kolb, Bajohr
WS 19/20	22311	Praktikum Prozess- und Anlagentechnik	1 SWS	Practical course (P)	Kolb, und Mitarbeiter

3.68 Course: Innovation Management for Products & Processes in the Chemical Industry [T-CIWVT-108980]

Responsible: Dr. Claudius Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104397 - Innovation Management for Products & Processes in the Chemical Industry

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	22328	Innovationsmanagement für Produkte und Prozesse der chemischen Industrie	2 SWS	Block (B)	Sauer, Neumann

Competence Certificate
The examination is a written examination (multiple choice) with a duration of 30 minutes (section 4 subsection 2 number 1 SPO).

Prerequisites
None

T 3.69 Course: Instrumental Analysis [T-CIWVT-106837]

Responsible: Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104560 - Instrumental Analysis

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2020	22942	Instrumental Analyses	2 SWS	Lecture (V)	Guthausen

Competence Certificate
Oral exam, about 30 min

Prerequisites
None

T 3.70 Course: Integrated Bioprocesses [T-CIWVT-106031]

Responsible: Prof. Dr. Clemens Posten
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104386 - Integrated Bioprocesses

Type	Credits	Version
Written examination	6	1

Events					
SS 2020	22946	Integrated Bioprocesses	4 SWS	Lecture (V)	Posten

T 3.71 Course: Internship [T-CIWVT-109276]

Responsible: Dr.-Ing. Siegfried Bajohr
Dr.-Ing. Barbara Freudig

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-104527 - Internship

Type	Credits	Recurrence	Version
Completed coursework (practical)	14	Each term	1

Prerequisites

None

T 3.72 Course: Internship Food Process Engineering [T-CIWVT-110578]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104257 - Practical Course in Food Process Engineering

Type	Credits	Version
Completed coursework	2	1

3.73 Course: Introduction to Sensory Analysis with Practice [T-CIWVT-109128]

Responsible: Dr. Franz Eckert
Jun.-Prof. Dr. Katharina Scherf

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-104257 - Practical Course in Food Process Engineering

Type	Credits	Recurrence	Version
Examination of another type	2	Each summer term	1

Events					
SS 2020	6630	Einführung in die Sensorik mit Übungen	1 SWS	Lecture (V)	Scherf

Prerequisites

None

T 3.74 Course: Kinetics and Catalysis [T-CIWVT-106032]

Responsible: Prof. Dr. Bettina Kraushaar-Czarnetzki
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104383 - Kinetics and Catalysis

Type	Credits	Recurrence	Version
Written examination	6	Each term	1

Events					
SS 2020	22119	Kinetik und Katalyse	2 SWS	Lecture (V)	Kraushaar-Czarnetzki
SS 2020	22120	Übung zu Kinetik und Katalyse (22119)	1 SWS	Practice (Ü)	Kraushaar-Czarnetzki, und Mitarbeiter
SS 2020	22121	Repetitorium zur Klausur Kinetik und Katalyse	2 SWS	Practice (Ü)	Kraushaar-Czarnetzki, und Mitarbeiter

T 3.75 Course: Laboratory Work for NMR for Engineers [T-CIWVT-109144]

Responsible: Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104401 - NMR for Engineers

Type	Credits	Recurrence	Version
Completed coursework (practical)	2	Each winter term	1

Events					
WS 19/20	22954	NMR for Engineers	SWS	Lecture (V)	Guthausen
WS 19/20	22955	Praktikum zu 22954 NMR im Ingenieurwesen (MVM-VM, EBI-WCT)	2 SWS	Practical course (P)	Guthausen

Prerequisites
None

T 3.76 Course: Mass Transfer II [T-CIWVT-108935]

Responsible: Prof. Dr.-Ing. Wilhelm Schabel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104369 - Mass Transfer II

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22817	Stoffübertragung II	1 SWS	Lecture (V)	Schabel
WS 19/20	22818	Übung zu 22817 Stoffübertragung II	2 SWS	Practice (Ü)	Schabel, und Mitarbeiter

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.77 Course: Master-Thesis [T-CIWVT-109275]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Prof. Dr. Reinhard Rauch

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-104526 - Module Master Thesis

Type	Credits	Recurrence	Version
Final Thesis	30	Each term	2

Prerequisites

Process Technology and at least three further modules of the advanced fundamentals has to be passed. The intership has to be passed. The examination board decides on exceptions.

(Compare SPO section 14 subsection 1)

Final Thesis

This course represents a final thesis. The following periods have been supplied:

Submission deadline	6 months
Maximum extension period	4 weeks
Correction period	8 weeks

T 3.78 Course: Materials for Electrochemical Storage [T-CIWVT-108913]

Responsible: Prof. Dr. Jens Tübke
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104353 - Materials for Electrochemical Storage

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22990	Materialien für elektrochemische Speicher und Wandler	2 SWS	Lecture (V)	Tübke
SS 2020	22990	Materials and Processes of Electrochemical Sorage Devices	2 SWS	Lecture (V)	Tübke

Competence Certificate
The examination is an oral examination with a duration about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.79 Course: Measurement Techniques in Chemical Processing [T-CIWVT-109086]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104450 - Measurement Techniques in Chemical Processing (including practical course)
M-CIWVT-104490 - Measurement Techniques in Chemical Processing

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22126	Messmethoden in der Chemischen Verfahrenstechnik	2 SWS	Lecture (V)	Müller
SS 2020	22127	Praktikum zu 22126 Messmethoden in der Chemischen Verfahrenstechnik	1 SWS	Practical course (P)	Müller

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.80 Course: Measurement Techniques in the Thermo-Fluid Dynamics [T-CIWVT-108837]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104297 - Measurement Techniques in the Thermo-Fluid Dynamics

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22509	Diagnostics in thermal fluid dynamics	2 SWS	Lecture (V)	Trimis
WS 19/20	22510	Exercises for 22509 Diagnostics in thermal fluid dynamics	1 SWS	Practice (Ü)	Trimis

Prerequisites
None

T 3.81 Course: Membrane Technologies in Water Treatment [T-CIWVT-110865]

Responsible: Prof. Dr. Harald Horn
Dr.-Ing. Florencia Saravia

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-105380 - Membrane Technologies in Water Treatment

Type	Credits	Recurrence	Version
Oral examination	5	Each summer term	1

Events					
SS 2020	22605	Membrane Technologies in Water Treatment	2 SWS	Lecture (V)	Horn, Saravia
SS 2020	22606	Practical in Membrane Technologies in Water Treatment	1 SWS	Practice (Ü)	Horn, Saravia, und Mitarbeiter

Competence Certificate
Learning control is an oral examination with a duration of about 30 minutes (SPO section 4 subsection 2).

Prerequisites
The attendance at the excursions is examination prerequisite.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-110864 - Excursions: Membrane Technologies must have been passed.

T 3.82 Course: Methods and Processes of PGE - Product Generation Development [T-MACH-109192]

Responsible: Prof. Dr.-Ing. Albert Albers
Norbert Burkardt
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102718 - Product Development - Methods of Product Development

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2020	2146176	Methods and processes of PGE - Product Generation Development	4 SWS	Lecture (V)	Albers

Competence Certificate
Written exam (processing time: 120 min + 10 min reading time)

Auxiliaries:

- Calculator
- German dictionary (books only)

Prerequisites
None

Annotation
This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

T 3.83 Course: Microbiology for Engineers [T-CIWVT-106834]

Responsible: Prof. Dr. Thomas Schwartz
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104319 - Microbiology for Engineers

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22633	Microbiology for Engineers	2 SWS	Lecture (V)	Schwartz

T 3.84 Course: Microfluidics [T-CIWVT-108909]

Responsible: Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104350 - Microfluidics
M-CIWVT-105205 - Microfluidics and Case Studies

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	22964	Microfluidics - Basics and Applications	2 SWS	Lecture (V)	Leneweit

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.85 Course: Microfluidics - Case Studies [T-CIWVT-110549]

Responsible: Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105205 - Microfluidics and Case Studies

Type	Credits	Recurrence	Version
Completed coursework	2	Each winter term	1

Events					
WS 19/20	22971	Microfluidics - Basics and Applications with Lab Training	1 SWS	Practical course (P)	Leneweit

Prerequisites
None

T 3.86 Course: Microrheology and High Frequency Rheology [T-CIWVT-108977]

Responsible: Dr.-Ing. Claude Oelschlaeger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104395 - Microrheology and High Frequency Rheology

Type	Credits	Recurrence	Version
Oral examination	2	Each summer term	1

Events					
SS 2020	22968	Mikrorheologie und Hochfrequenzrheometrie	1 SWS	Lecture (V)	Oelschlaeger

Prerequisites
None

T 3.87 Course: Mixing, Stirring, Agglomeration [T-CIWVT-110895]

Responsible: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105399 - Mixing, Stirring, Agglomeration

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22907	Mixing, Stirring and Agglomeration	3 SWS	Lecture (V)	Nirschl

Competence Certificate
Learning control is an oral individual examination with a duration of 30min according SPO section 4, subsection 2.

Prerequisites
None

T 3.88 Course: Modern Analysis Techniques for Process Optimization [T-CIWVT-108959]

Responsible: Marc Regier
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104387 - Modern Analysis Techniques for Process Optimization

Type	Credits	Recurrence	Version
Oral examination	2	Each summer term	1

Events					
SS 2020	22218	Moderne Messtechniken zur Prozessoptimierung	2 SWS	Lecture (V)	Regier

Competence Certificate
The examination is an oral examination with a duration of about 15 - 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.89 Course: Multiphase Reaction Engineering [T-CIWVT-108815]

Responsible: Prof. Dr. Bettina Kraushaar-Czarnetzki
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104277 - Multiphase Reaction Engineering

Type	Credits	Recurrence	Version
Oral examination	10	Each winter term	1

Events					
WS 19/20	22122	Chemische Verfahrenstechnik II	2 SWS	Lecture (V)	Kraushaar-Czarnetzki
WS 19/20	22123	Übung und Repetitorium zu 22122 und 22125	2 SWS	Practice (Ü)	Kraushaar-Czarnetzki
WS 19/20	22125	Heterogene Katalyse I	1 SWS	Lecture (V)	Kraushaar-Czarnetzki

Competence Certificate
The examination is an oral examination with a duration of 40 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.90 Course: Nanoparticles – Structure and Function [T-CIWVT-108894]

Responsible: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104339 - Nanoparticles – Structure and Function

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22936	Nanopartikel Struktur und Funktion	2 SWS	Lecture (V)	Meyer
SS 2020	22937	Übungen zu 22936 Nanopartikel Struktur und Funktion	1 SWS	Practice (Ü)	Meyer

Competence Certificate
The examination is an oral examination with a duration of 30 minutes (single examination) or 20 minutes (comprehensive examination in VF Gas-Partikel-Systeme) (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.91 Course: NMR for Engineers [T-CIWVT-108984]

Responsible: Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104401 - NMR for Engineers

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22954	NMR for Engineers	SWS	Lecture (V)	Guthausen
WS 19/20	22955	Praktikum zu 22954 NMR im Ingenieurwesen (MVM-VM, EBI-WCT)	2 SWS	Practical course (P)	Guthausen

Competence Certificate
The examination consists of:

1. labwork, ungraded, § 4 Abs. 3 SPO

2. oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Labwork is required for the oral examination.

Prerequisites
Labwork must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-109144 - Laboratory Work for NMR for Engineers must have been passed.

T 3.92 Course: Numerical Methods in Fluid Mechanics [T-MATH-105902]

Responsible: Prof. Dr. Willy Dörfler
PD Dr. Gudrun Thäter

Organisation: KIT Department of Mathematics

Part of: M-MATH-102932 - Numerical Methods in Fluid Mechanics

Type	Credits	Version
Oral examination	4	1

Events					
SS 2020	0164200	Numerische Methoden in der Strömungsmechanik	2 SWS	Lecture (V)	Thäter
SS 2020	0164210	Übungen zu 0164210 (numerische Methoden in der Strömungsmechanik)	1 SWS	Practice (Ü)	Thäter

T 3.93 Course: Nutritional Consequences of Food Processing [T-CIWVT-108792]

Responsible: PD Dr. Karlis Briviba
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104255 - Nutritional Consequences of Food Processing

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22225	Nutritional consequences of food processing	2 SWS	Lecture (V)	Briviba

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.94 Course: Organ Support Systems [T-MACH-105228]

Responsible: Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102702 - Organ Support Systems

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2020	2106008	Organ support systems	2 SWS	Lecture (V)	Pylatiuk

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

T 3.95 Course: Particle Technology Exam [T-CIWVT-106028]

Responsible: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104378 - Particle Technology

Type	Credits	Version
Written examination	6	1

Events					
SS 2020	22975	Partikeltechnik	2 SWS	Lecture (V)	Dittler
SS 2020	22976	Übungen in kleinen Gruppen zu 22975 Partikeltechnik	1 SWS	Practice (Ü)	Dittler, und Mitarbeiter

T 3.96 Course: Physical Chemistry (lab) [T-CHEMBIO-109179]

Responsible: Dr. Detlef Nattland
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-104486 - Physical Chemistry (incl. Lab)

Type	Credits	Recurrence	Version
Completed coursework (practical)	2	Each winter term	1

Events					
WS 19/20	5209	Physikalische Chemie für Chemieingenieure	2 SWS	Lecture (V)	Nattland
WS 19/20	5210	Übungen zur Vorlesung Physikalische Chemie für Chemieingenieure	1 SWS	Practice (Ü)	Nattland
WS 19/20	5239	Physikalisch-chemisches Praktikum für Chemieingenieure (Master)	2 SWS	Practical course (P)	Nattland, Die Dozenten des Instituts

Competence Certificate
The examination consists of two Parts:

1. written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO)
2. practical course, ungraded study achievement (§ 4 Abs. 3 SPO)

Prerequisites
None

T 3.97 Course: Physical Chemistry (written exam) [T-CHEMBIO-109178]

Responsible: Dr. Detlef Nattland
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-104486 - Physical Chemistry (incl. Lab)

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	5209	Physikalische Chemie für Chemieingenieure	2 SWS	Lecture (V)	Nattland
WS 19/20	5210	Übungen zur Vorlesung Physikalische Chemie für Chemieingenieure	1 SWS	Practice (Ü)	Nattland
WS 19/20	5239	Physikalisch-chemisches Praktikum für Chemieingenieure (Master)	2 SWS	Practical course (P)	Nattland, Die Dozenten des Instituts

Competence Certificate
The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).

Prerequisites
Lab work has to be passed.

T 3.98 Course: Physical Foundations of Cryogenics [T-CIWVT-106103]

Responsible: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103068 - Physical Foundations of Cryogenics

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22030	Physical Foundations of Cryogenics	2 SWS	Lecture (V)	Grohmann
SS 2020	22031	Physical Foundations of Cryogenics - Exercises	1 SWS	Practice (Ü)	Grohmann

Prerequisites
None

T 3.99 Course: Practical Course Combustion Technology [T-CIWVT-108873]

Responsible: Dr.-Ing. Stefan Raphael Harth
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104321 - Practical Course Combustion Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22542	Verbrennungstechnisches Praktikum	3 SWS	Practical course (P)	Zarzalis, Trimis, Harth

Competence Certificate
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

3.100 Course: Practical Course in Water Technology [T-CIWVT-106840]

Responsible: Dr. Gudrun Abbt-Braun
Dr. Andrea Hille-Reichel
Prof. Dr. Harald Horn

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-103440 - Practical Course in Water Technology

Type	Credits	Recurrence	Version
Examination of another type	3	Each winter term	2

Events					
WS 19/20	22664	Practical course: Water quality and water assessment	2 SWS	Practical course (P)	Horn, Abbt-Braun, und Mitarbeiter

Competence Certificate
The learning: 6 Experiments including entrance test, protocol; presentation about a selected experiment (about 15 minutes); final test (SPO section 4, subsection 2 No. 3).

Prerequisites
None

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-CIWVT-103407 - Water Technology must have been started.

T 3.101 Course: Practical Course Measurement Techniques in Chemical Processing [T-CIWVT-109181]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104450 - Measurement Techniques in Chemical Processing (including practical course)

Type	Credits	Recurrence	Version
Completed coursework (practical)	2	Each summer term	1

Events					
SS 2020	22126	Messmethoden in der Chemischen Verfahrenstechnik	2 SWS	Lecture (V)	Müller
SS 2020	22127	Praktikum zu 22126 Messmethoden in der Chemischen Verfahrenstechnik	1 SWS	Practical course (P)	Müller
SS 2020	22129	Kolloquium zu Messmethoden in der Chemischen Verfahrenstechnik	SWS	Colloquium (KOL)	Müller

Competence Certificate
The examination is an ungraded laboratory work (section 4 subsection 3 SPO).

Prerequisites
None

T 3.102 Course: Practical Course Measurement Techniques in Chemical Processing [T-CIWVT-109182]

Responsible: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104491 - Catalytic Micro Reactors (including practical course)

Type	Credits	Recurrence	Version
Completed coursework (practical)	2	Each summer term	1

Events					
SS 2020	22137	Praktikum zu 22136 Katalytische Mikroreaktoren	1 SWS	Practical course (P)	Pfeifer, Dittmeyer, und Mitarbeiter

Prerequisites
None

T 3.103 Course: Practical Course Process Technology and Plant Design [T-CIWVT-106148]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104374 - Process Technology

Type	Credits	Recurrence	Version
Completed coursework (practical)	0	Each winter term	1

Events					
WS 19/20	22311	Praktikum Prozess- und Anlagentechnik	1 SWS	Practical course (P)	Kolb, und Mitarbeiter

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-106149 - Initial Exam Process Technology and Plant Design must have been passed.

T 3.104 Course: Practical Course Sol-Gel Processes [T-CIWVT-108823]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104284 - Sol-Gel-Processes (Including Practical Course)

Type	Credits	Recurrence	Version
Completed coursework (practical)	2	Each summer term	1

Events					
WS 19/20	22111		1 SWS	Practical course (P)	Müller

Competence Certificate
Ungraded laboratory work (section 4, subsection 3 SPO).

Prerequisites
None

T 3.105 Course: Practical in Additive Manufacturing for Process Engineering [T-CIWVT-110903]

Responsible: Prof. Dr.-Ing. Roland Dittmeyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105407 - Additive Manufacturing for Process Engineering

Type	Credits	Version
Completed coursework (practical)	1	1

Events					
SS 2020	22104	Practical in Additive Manufacturing for Process Engineering	1 SWS	Practical course (P)	Dittmeyer, Ladewig, Navarrete Munoz

T 3.106 Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

Responsible: Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-CIWVT-104886 - Principles of Ceramic and Powder Metallurgy Processing

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2193010	Basic principles of powder metallurgical and ceramic processing	2 SWS	Lecture (V)	Schell

Competence Certificate
The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

Prerequisites
none

T 3.107 Course: Principles of Medicine for Engineers [T-MACH-105235]

Responsible: Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102720 - Principles of Medicine for Engineers

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2105992	Principles of Medicine for Engineers	2 SWS	Lecture (V)	Pylatiuk

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

T 3.108 Course: Process and Plant Safety [T-CIWVT-108912]

Responsible: Prof. Jürgen Schmidt
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104352 - Process and Plant Safety

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22308	Process and Plant Safety	2 SWS	Lecture (V)	Schmidt

Competence Certificate
Erfolgskontrolle ist eine mündliche Prüfung im Umfang von ca. 30 Minuten nach § 4 Abs. 2 Nr. 2 SPO.

Prerequisites
None

T 3.109 Course: Process Instruments and Machinery and their Process Integration [T-CIWVT-108910]

Responsible: Manfred Nagel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104351 - Process Instruments and Machinery and their Process Integration

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22941	Process Instruments and Machinery and their Process Integration	2 SWS	Block (B)	Nagel

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.110 Course: Process Modeling in Downstream Processing [T-CIWVT-106101]

Responsible: Prof. Dr.-Ing. Matthias Franzreb
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103066 - Process Modeling in Downstream Processing

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
SS 2020	22717	Process Modeling in Downstream Processing	2 SWS	Lecture (V)	Franzreb

Prerequisites
None

T 3.111 Course: Process Technology and Plant Design Written Exam [T-CIWVT-106150]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104374 - Process Technology

Type	Credits	Recurrence	Version
Written examination	8	Each term	1

Events					
WS 19/20	22301	Prozess- und Anlagentechnik I, Grundlagen der Ingenieurstechnik	2 SWS	Lecture (V)	Kolb, Bajohr
WS 19/20	22311	Praktikum Prozess- und Anlagentechnik	1 SWS	Practical course (P)	Kolb, und Mitarbeiter
SS 2020	22302	Prozess - und Anlagentechnik II - Prozesse	3 SWS	Lecture (V)	Kolb, Bajohr

T 3.112 Course: Processes and Process Chains for Renewable Resources [T-CIWVT-108997]

Responsible: Prof. Dr. Nicolaus Dahmen
Prof. Dr.-Ing. Jörg Sauer

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-104422 - Processes and Process Chains for Renewable Resources

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22323	Verfahren und Prozessketten für nachwachsende Rohstoffe	2 SWS	Lecture (V)	Dahmen
WS 19/20	22324		1 SWS	Practice (Ü)	Dahmen
SS 2020	22323	Verfahren und Prozessketten für nachwachsende Rohstoffe	3 SWS	Lecture / Practice (VÜ)	Dahmen, Sauer

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.113 Course: Processing of Nanostructured Particles [T-CIWVT-106107]

Responsible: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103073 - Processing of Nanostructured Particles

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22921	Processing of Nanostructured Particles	2 SWS	Lecture (V)	Nirschl

Prerequisites
None

T 3.114 Course: Product Design II [T-CIWVT-108979]

Responsible: Prof. Dr.-Ing. Matthias Kind
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104396 - Product Design II

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22833	Produktgestaltung II	2 SWS	Lecture (V)	Kind

Competence Certificate
The examination is an oral examination with a duration of 30 minutes.

Prerequisites
None

T 3.115 Course: Project Centered Software-Lab [T-MATH-105907]

Responsible: PD Dr. Gudrun Thäter
Organisation: KIT Department of Mathematics
Part of: M-MATH-102938 - Project Centered Software-Lab

Type	Credits	Version
Examination of another type	4	1

Events					
SS 2020	0161700	Projektorientiertes Softwarepraktikum	4 SWS	Practical course (P)	Thäter, Krause

Prerequisites
none

T 3.116 Course: Reaction Kinetics [T-CIWVT-108821]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104283 - Reaction Kinetics

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22106	Reaktionskinetik	2 SWS	Lecture (V)	Müller
WS 19/20	22107	Übungen Reaktionskinetik	1 SWS	Practice (Ü)	Müller

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.117 Course: Refinery Technology - Liquid Fuels [T-CIWVT-108831]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104291 - Refinery Technology - Liquid Fuels

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22310	Raffinerietechnik - Flüssige Energieträger	2 SWS	Lecture (V)	Rauch
SS 2020	22312	Übung zu 22310 Raffinerietechnik	1 SWS	Practice (Ü)	Rauch, und Mitarbeiter

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.118 Course: Refrigeration B - Foundations of Industrial Gas Processing [T-CIWVT-108914]

Responsible: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104354 - Refrigeration B - Foundations of Industrial Gas Processing

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22014	Kältetechnik B	2 SWS	Lecture (V)	Grohmann
SS 2020	22015	Übungen zu 22014 Kältetechnik B	1 SWS	Practice (Ü)	Grohmann, und Mitarbeiter

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.119 Course: Research Lab Food Process Engineering [T-CIWVT-110577]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104257 - Practical Course in Food Process Engineering

Type	Credits	Version
Examination of another type	2	1

T 3.120 Course: Rheology and Processing of Disperse Systems [T-CIWVT-108891]

Responsible: Dr.-Ing. Claude Oelschlaeger
Prof. Dr. Norbert Willenbacher

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-104336 - Rheology and Processing of Disperse Systems

Type	Credits	Recurrence	Version
Oral examination	8	Each term	1

Events					
WS 19/20	22916	Stabilität disperser Systeme	2 SWS	Lecture (V)	Oelschlaeger, Willenbacher
SS 2020	22922	Rheologie disperser Systeme	1 SWS	Lecture (V)	Willenbacher
SS 2020	22968	Mikrorheologie und Hochfrequenzrheometrie	1 SWS	Lecture (V)	Oelschlaeger

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.121 Course: Rheology and Processing of Polymers [T-CIWVT-108890]

Responsible: Dr.-Ing. Bernhard Hochstein
Prof. Dr. Norbert Willenbacher

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-104335 - Rheology and Processing of Polymers

Type	Credits	Recurrence	Version
Oral examination	8	Each summer term	1

Events					
SS 2020	22924	Rheologie von Polymeren	2 SWS	Lecture (V)	Willenbacher
SS 2020	22949	Rheometrie und Rheologie	2 SWS	Lecture (V)	Hochstein

Competence Certificate
he examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.122 Course: Rheology and Rheometry [T-CIWVT-108881]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104326 - Rheology and Rheometry

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22949	Rheometrie und Rheologie	2 SWS	Lecture (V)	Hochstein

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.123 Course: Rheology of Complex Fluids and Advanced Rheometry [T-CIWVT-108886]

Responsible: Dr.-Ing. Claude Oelschlaeger
Prof. Dr. Norbert Willenbacher

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-104331 - Rheology of Complex Fluids and Advanced Rheometry

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22922	Rheologie disperser Systeme	1 SWS	Lecture (V)	Willenbacher
SS 2020	22968	Mikrorheologie und Hochfrequenzrheometrie	1 SWS	Lecture (V)	Oelschlaeger

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.124 Course: Rheology of Disperse Systems [T-CIWVT-108963]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104391 - Rheology of Disperse Systems

Type	Credits	Recurrence	Version
Oral examination	2	Each summer term	1

Events					
SS 2020	22922	Rheologie disperser Systeme	1 SWS	Lecture (V)	Willenbacher

Prerequisites
None

T 3.125 Course: Rheology of Polymers [T-CIWVT-108884]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104329 - Rheology of Polymers

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2020	22924	Rheologie von Polymeren	2 SWS	Lecture (V)	Willenbacher

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.126 Course: Selected Formulation Technologies [T-CIWVT-106037]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103064 - Selected Formulation Technologies

Type	Credits	Version
Written examination	6	1

Events					
WS 19/20	22209		1 SWS	Lecture (V)	van der Schaaf
WS 19/20	22226		1 SWS	Lecture (V)	Wittner
WS 19/20	22229		1 SWS	Lecture (V)	Wittner
WS 19/20	22246	Extrusion technology in food processing	1 SWS	Lecture (V)	Emin

3.127 Course: Seminar Biotechnological Production [T-CIWVT-108492]

Responsible: Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104384 - Biotechnological Production

Type	Credits	Recurrence	Version
Completed coursework	0	Each summer term	1

Events					
SS 2020	22409	Übung zu 22410 Biotechnologische Stoffproduktion	2 SWS	Practice (Ü)	Syldatk
SS 2020	22410	Biotechnical Production Methods	2 SWS	Lecture (V)	Syldatk

T 3.128 Course: Seminar of Food Processing in Practice with Excursion [T-CIWVT-109129]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104257 - Practical Course in Food Process Engineering

Type	Credits	Recurrence	Version
Completed coursework (practical)	2	Each winter term	2

Events					
WS 19/20	22248	Seminar Food Processing in Practice, incl. Excursion	3 SWS	Block (B)	Wittner, und Mitarbeiter

Prerequisites
None

T 3.129 Course: Solar Process Technology [T-CIWVT-108934]

Responsible: Dr. Martina Neises-von Puttkamer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104368 - Solar Process Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22848	Solare Prozesstechnik	2 SWS	Lecture (V)	Neises-von Puttkamer
SS 2020	22849	Übung zu 22848 Solare Prozesstechnik	1 SWS	Practice (Ü)	Neises-von Puttkamer

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.130 Course: Sol-Gel Processes [T-CIWVT-108822]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104284 - Sol-Gel-Processes (Including Practical Course)
M-CIWVT-104489 - Sol-Gel Processes

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
WS 19/20	22110		2 SWS	Lecture (V)	Müller

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.131 Course: Solid Liquid Separation [T-CIWVT-108897]

Responsible: Dr.-Ing. Harald Anlauf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104342 - Solid Liquid Separation

Type	Credits	Recurrence	Version
Oral examination	8	Each winter term	1

Events					
WS 19/20	22987	Mechanische Separationstechnik	3 SWS	Lecture (V)	Anlauf
WS 19/20	22988	Übung zu 22987 Mechanische Separationstechnik	1 SWS	Practice (Ü)	Anlauf

Competence Certificate
The examination is an oral examination with a duration of 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.132 Course: Stability of Disperse Systems [T-CIWVT-108885]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104330 - Stability of Disperse Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22916	Stabilität disperser Systeme	2 SWS	Lecture (V)	Oelschlaeger, Willenbacher

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.133 Course: Statistical Thermodynamics [T-CIWVT-106098]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103059 - Statistical Thermodynamics

Type	Credits	Version
Oral examination	6	1

Prerequisites
None

T 3.134 Course: Structure and Reaction of Aquatic Humic Substances [T-CIWVT-108842]

Responsible: Dr. Gudrun Abbt-Braun
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104302 - Structure and Reaction of Aquatic Humic Substances

Type	Credits	Recurrence	Version
Oral examination	2	Each summer term	1

Events					
SS 2020	22615	Structur and Reactions of Aquatic Humic Substances	1 SWS	Lecture (V)	Abbt-Braun

Competence Certificate
The examination is an oral examination with a duration of about 15 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.135 Course: Supercritical Fluid Technology [T-CIWVT-108923]

Responsible: Prof. Dr.-Ing. Michael Türk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104362 - Supercritical Fluid Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22021	Supercritical fluid technology and applications	3 SWS	Lecture / Practice (VÜ)	Türk

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.136 Course: Surface Effects in Process Engineering [T-CIWVT-109088]

Responsible: Ioannis Nicolaou
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104452 - Surface Effects in Process Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22948	Grenzflächeneffekte in der Verfahrenstechnik	2 SWS	Lecture (V)	Nicolaou

Prerequisites
None

T 3.137 Course: Technical Systems for Thermal Waste Treatment [T-CIWVT-108830]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104290 - Technical Systems for Thermal Waste Treatment

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	22516	Technical Systems for Thermal Waste Treatment	2 SWS	Lecture (V)	Kolb

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.138 Course: Technology-Driven Business Start-up – Information for prospective Founders and Interesting Success Stories [T-CIWVT-110580]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105210 - Technology-Driven Business Start-up – Information for prospective Founders and Interesting Success Stories

Type	Credits	Version
Oral examination	4	1

Events					
WS 19/20	22903		2 SWS	Lecture (V)	Willenbacher, und Mitarbeiter

Competence Certificate
Learning control is an oral examination with a duration of about 20 minutes (SPO section 2 subsection 2).

Prerequisites
None

T 3.139 Course: Term Paper 'International Sanitary Engineering' [T-BGU-109265]

Responsible: Dr.-Ing. Stephan Fuchs
Dr.-Ing. Tobias Morck

Organisation: KIT Department of Civil Engineering, Geo- and Environmental Sciences

Part of: M-BGU-104917 - Wastewater Treatment Technologies

Type	Credits	Recurrence	Version
Completed coursework	1	Each winter term	2

Events					
WS 19/20	6223902	International Sanitary Engineering	2 SWS	Lecture / Practice (VÜ)	Fuchs, Morck

Competence Certificate
presentation, appr. 15 min., term paper, appr. 10 pages

Prerequisites
none

Recommendation
none

Annotation
none

T 3.140 Course: Theory of Turbulent Flows without and with Superimposed Combustion [T-CIWVT-106108]

Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103074 - Theory of Turbulent Flows without and with Superimposed Combustion

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
SS 2020	22514	Theorie turbulenter Strömungen ohne und mit überlagerter Verbrennung	2 SWS	Lecture (V)	Zarzalis

Prerequisites
None

T 3.141 Course: Thermal Separation Processes II [T-CIWVT-108926]

Responsible: Prof. Dr.-Ing. Matthias Kind
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104365 - Thermal Separation Processes II

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22812	Thermische Trennverfahren II	2 SWS	Lecture (V)	Kind
WS 19/20	22813	Übungen zu 22812 Thermische Trennverfahren II	1 SWS	Practice (Ü)	Kind

Competence Certificate
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.142 Course: Thermal Transport Processes [T-CIWVT-106034]

Responsible: Prof. Dr.-Ing. Matthias Kind
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104377 - Thermal Transport Processes

Type	Credits	Recurrence	Version
Written examination	6	Each term	1

Events					
SS 2020	22824	Thermische Transportprozesse (MA)	2 SWS	Lecture (V)	Kind, Schabel, Wetzel
SS 2020	22825	Übung zu 22824 Thermische Transportprozesse	2 SWS	Practice (Ü)	Kind, Wetzel, Schabel, und Mitarbeiter

T 3.143 Course: Thermo- and Particle Dynamics of Particular Systems [T-CIWVT-108924]

Responsible: Prof. Dr.-Ing. Michael Türk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104363 - Thermo- and Particle Dynamics of Particular Systems

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2020	22022	Partikel- und Thermodynamik disperser Systeme - Vorlesung und Übung	3 SWS	Block (B)	Türk

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.144 Course: Thermodynamics III [T-CIWVT-106033]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103058 - Thermodynamics III

Type	Credits	Version
Written examination	6	1

Events					
WS 19/20	22008	Thermodynamics III	2 SWS	Lecture (V)	Enders
WS 19/20	22009	Thermodynamics III - exercises	1 SWS	Practice (Ü)	Enders, und Mitarbeiter

T 3.145 Course: Thermodynamics of Interfaces [T-CIWVT-106100]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103063 - Thermodynamics of Interfaces

Type	Credits	Version
Oral examination	4	1

Events					
SS 2020	22012	Grenzflächenthermodynamik	2 SWS	Lecture (V)	Enders
SS 2020	22013	Übungen zu 22012 Grenzflächenthermodynamik	1 SWS	Practice (Ü)	Enders

Competence Certificate
Erfolgskontrolle ist eine mündliche Prüfung im Umfang von 30 Minuten.

T 3.146 Course: Thermodynamics of Phase Equilibria [T-CIWVT-108921]

Responsible: Prof. Dr.-Ing. Michael Türk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104360 - Thermodynamics of Phase Equilibria

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22016	Thermodynamics of phase equilibria	3 SWS	Lecture / Practice (VÜ)	Türk

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.147 Course: Transport and Storage of Chemical Energy Carriers [T-CIWVT-110916]

Responsible: Prof. Dr.-Ing. Thomas Kolb
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105406 - Transport and Storage of Chemical Energy Carriers

Type	Credits	Version
Oral examination	4	1

Events					
SS 2020	22332	Transport and Storage of Chemical Energy Carriers (ENTECH)	2 SWS	Lecture (V)	Kolb

T 3.148 Course: Unit Operations and Process Chains for Food of Animal Origin [T-CIWVT-108996]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104421 - Unit Operations and Process Chains for Food of Animal Origin

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
SS 2020	22210	Verfahren und Prozessketten für Lebensmittel aus tierischen Rohstoffen (ehem. LVT)	2 SWS	Lecture (V)	Karbstein

Prerequisites
None

T 3.149 Course: Unit Operations and Process Chains for Food of Plant Origin [T-CIWVT-108995]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104420 - Unit Operations and Process Chains for Food of Plant Origin

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22210	Verfahren und Prozessketten für Lebensmittel pflanzlicher Herkunft (ehem. LVT)	3 SWS	Lecture (V)	Wittner

Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.150 Course: Vacuum Technology [T-CIWVT-109154]

Responsible: Dr. Christian Day
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104478 - Vacuum Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22033	Übung zu Vakuumtechnik (22034)	1 SWS	Practice (Ü)	Day, Varoutis
WS 19/20	22034	Vakuumtechnik	2 SWS	Lecture (V)	Day

Competence Certificate
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.151 Course: Wastewater Treatment Technologies [T-BGU-109948]

Responsible: Dr.-Ing. Stephan Fuchs
Dr.-Ing. Tobias Morck

Organisation: KIT Department of Civil Engineering, Geo- and Environmental Sciences

Part of: M-BGU-104917 - Wastewater Treatment Technologies

Type	Credits	Recurrence	Version
Written examination	5	Each winter term	1

Events					
WS 19/20	6223901	Municipal Wastewater Treatment	2 SWS	Lecture / Practice (VÜ)	Morck
WS 19/20	6223902	International Sanitary Engineering	2 SWS	Lecture / Practice (VÜ)	Fuchs, Morck

Competence Certificate
written exam, 60 min.

Prerequisites
The accomplishment Term paper 'International Sanitary Engineering' (T-BGU-109265) has to be passend.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-BGU-109265 - Term Paper 'International Sanitary Engineering' must have been passed.

Recommendation
none

Annotation
none

T 3.152 Course: Water Quality Assessment [T-CIWVT-108841]

Responsible: Dr. Gudrun Abbt-Braun
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104301 - Water Quality Assessment

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22603	Scientific principles for water quality assessment	2 SWS	Lecture (V)	Abbt-Braun
WS 19/20	22604	Excercises and demonstration for 22603 Scientific principles for water quality assessment	1 SWS	Practice (Ü)	Abbt-Braun, Horn, und Mitarbeiter

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 3.153 Course: Water Technology [T-CIWVT-106802]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103407 - Water Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	22621	Water Technology	2 SWS	Lecture (V)	Horn
WS 19/20	22622	Excersises to Water Technology	1 SWS	Practice (Ü)	Horn, und Mitarbeiter