



UNIVERSITÄT  
HOHENHEIM

# Modulhandbuch

für den Studiengang

Master of Science

Food Science and

Engineering

Stand Oktober 2019

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## Modul: Advanced Flavor Chemistry (1508-410)

Modulverantwortung	Yanyan Zhang
Teilnahmevoraussetzungen	Scientific background in chemistry and biotechnology
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 1)
Verbindlichkeit	Wahl
Studienleistung	Participation in lecture, seminar (presentation & report), and practice course (protocol)
Modulprüfung	Written exam (80%), seminar (20%), practical course (passed)
Prüfungsdauer	120 Minuten
Arbeitsaufwand	56h attendance + 140h independent studies = 196h workload
Fachkompetenzen / Lern- und Qualifikationsziele	This course will offer students the knowledge on flavour legislation, flavour analysis, aroma retention & release, flavour generation, flavour biotechnology, and the roles of flavour compounds on food process & storage.
Schlüsselkompetenzen	The students: • know the various analytical measurements of flavour compounds, correlated instrument and data analysis • arrange instrumental analyse and sensory evaluation on flavor compounds of food and drink using the proper methods and equipment • be familiar with presenting their work through written reports and oral presentations.
Anmerkungen	<a href="https://ilias.uni-hohenheim.de/ilias.php?ref_id=652887&amp;cmdClass=ilobjcoursegui&amp;cmd=view&amp;cmdNode=s0:hz&amp;baseClass=ilrepositorygui">https://ilias.uni-hohenheim.de/ilias.php?ref_id=652887&amp;cmdClass=ilobjcoursegui&amp;cmd=view&amp;cmdNode=s0:hz&amp;baseClass=ilrepositorygui</a>
<b>Advanced Flavor Chemistry (1508-411)</b>	
Person(en) verantwortlich	Yanyan Zhang
Person(en) begleitend	Dr. Martin Spraul
Lehrform	Vorlesung mit Übung
SWS	5
Inhalt	Lecture: Basic information on flavor property, individual aroma compounds and corresponding non-enzymatic or enzymatic pathways, flavor biotechnology, principles of analytical instruments involved in aroma analysis, sources of off-flavor compounds in raw materials, food processing and storage.

	Lab exercise: Perceiving and distinguishing the different odorants by sniffin sticks & Gas chromatography-olfactometry (GC-O) & data analysis of MS fragmentation & semi-quantification of odourants & bioflavor generation by submerged cultivation of edible basidiomycetes
Literatur	Belitz, H.D., Grosch, W., Schieberle, P.: Food Chemistry. Springer, 2009. Berger, R.G.: Flavours and Fragrances. Springer, 2007.

### **Advanced Flavor Chemistry (1508-411)**

Person(en) verantwortlich	Yanyan Zhang
Person(en) begleitend	Dr. Martin Spraul
Lehrform	Vorlesung mit Übung
SWS	5
Inhalt	Lecture: Basic information on flavor property, individual aroma compounds and corresponding non-enzymatic or enzymatic pathways, flavor biotechnology, principles of analytical instruments involved in aroma analysis, sources of off-flavor compounds in raw materials, food processing and storage.  Lab exercise: Perceiving and distinguishing the different odorants by sniffin sticks & Gas chromatography-olfactometry (GC-O) & data analysis of MS fragmentation & semi-quantification of odourants & bioflavor generation by submerged cultivation of edible basidiomycetes
Literatur	Belitz, H.D., Grosch, W., Schieberle, P.: Food Chemistry. Springer, 2009. Berger, R.G.: Flavours and Fragrances. Springer, 2007.

### **Advanced Flavor Chemistry (1508-412)**

Lehrform	Seminar
SWS	1
Inhalt	Evaluation of publications and research contributions. Conclusion of scientific literature, presenting and discussing on topic on flavour chemistry and biotechnology.

## **Modul: Advanced Meat Science and Techology (1507-500)**

Modulverantwortung	Prof. Dr. Jochen Weiss
Teilnahmevoraussetzungen	-
Sprache	englisch
ECTS	7,5

Angebotshäufigkeit	jedes WS
Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (Block 1)
Verbindlichkeit	Wahl
Studienleistung	Klausur, Referat/Vortrag
Prüfungsleistung	Klausur, Referat/Vortrag
Modulprüfung	Klausur 80%, Referat/Vortrag 20%
Prüfungsdauer	120 Minuten
Arbeitsaufwand	60 h Präsenzzeit + 165 h Eigenanteil = 225 h Arbeitsaufwand
Fachkompetenzen / Lern- und Qualifikationsziele	The aim of the course is that after completion of the course, students are able to recall knowledge of fundamental biochemical properties of animal-based raw materials. They understand various industrial processes used to convert these specific raw materials into various meat products. They generate self-reliantly the most popular and commonly manufactured meat products in teamwork. They perform the required process operations on a pilot plant scale to generate those products. They know and recognize the function and role of various additives and ingredients used to manufacture industrial meat products. They analyze and calculate the most important quality parameters for meat and meat products and know the legal framework. The students restructure raw material and technological elements according to a specific task into new products. They understand scale up issues and topics surrounding hygiene and safety of meat-based products.
Schlüsselkompetenzen	The aim of the course is that after completion of the course, students are able to have advanced knowledge in key unit operations. Participants apply critical problem assessments and discriminate tasks and targets with analytical thinking. They evaluate the results for evaluation of known quality criteria. They develop their creative potential, their ability to communicate and cooperate in teamwork. They represent scientific results in an appropriate manner and improve their verbal skills.
Anmerkungen	Anzahl Teilnehmerplätze: 24 Anmeldung zum Modul: Ilias 150 g Anmeldezeitraum: Registration opens 4 weeks prior to the start of the semester Kriterien, nach denen Studienplätze vergeben werden: in order of receipt
<b>Advanced Meat Science and Technology (1507-501)</b>	
Person(en) verantwortlich	Prof. Dr. Jochen Weiss
Person(en) begleitend	Kurt Herrmann, Dr. rer. nat. Monika Gibis
Lehrform	Vorlesung
SWS	2
Inhalt	A focus of the course is to introduce students to modern industrial processes used to generate the most popular and commonly

	<p>manufactured meat products, i.e. boiled, cooked or raw, fermented sausages and cooked or raw hams. Students will learn about the properties of raw materials used and issues surrounding their provisioning (e.g. slaughtering, cutting, conditioning or confectioning). The course features various guest speakers from industry that will introduce students to specific aspects of this industrial sector (e.g. encasing of products, smoking and drying of products, use of starter cultures). The course will allow an insight into key analytical methods that are required to comply with regulatory aspects of the meat products, such as method to analyze meat product quality and safety.</p>
Literatur	Script to the module
Anmerkungen	Registration opens 4 weeks prior to the start of the semester and closes at the beginning of the semester. First preference will be given to students enrolled in the M.Sc. Food Science and Engineering and then M.Sc. Food Biotechnology. Remaining free slots will then be given to students enrolled in other M.Sc. degree programs.
<b>Advanced Meat Science and Technology (1507-502)</b>	
Person(en) verantwortlich	Prof. Dr. Jochen Weiss
Person(en) begleitend	Kurt Herrmann, Dr. rer. nat. Monika Gibis
Lehrform	Übung
SWS	2
Inhalt	<p>A focus of the course is to introduce students to modern industrial processes used to generate the most popular and commonly manufactured meat products, i.e. boiled, cooked or raw, fermented sausages and cooked or raw hams. Students will participate in daily pilot plant exercises where they will have the opportunity to manufacture boiled, cooked or raw, fermented sausages and cooked or raw hams products themselves. The course will allow an insight into key analytical methods and will analyze the most important analytical methods for meat products that are required to comply with regulatory aspects of the meat products. They will present their group exercise in a presentation.</p>
Literatur	Script to the module
Anmerkungen	Registration opens 4 weeks prior to the start of the semester and closes at the beginning of the semester. First preference will be given to students enrolled in the M.Sc. Food Science and Engineering and then M.Sc. Food Biotechnology. Remaining free slots will then be given to students enrolled in other M.Sc. degree programs.
<b>Advanced Meat Science and Technology (1507-503)</b>	
Person(en) verantwortlich	Prof. Dr. Jochen Weiss
Person(en) begleitend	Kurt Herrmann, Dr. rer. nat. Monika Gibis
Lehrform	Exkursion

SWS	1
Inhalt	The participants of the module will have the opportunity to visit one or more industrial meat product manufacturing facilities.
Literatur	Script to the module
Anmerkungen	Registration opens 4 weeks prior to the start of the semester and closes at the beginning of the semester. First preference will be given to students enrolled in the M.Sc. Food Science and Engineering and then M.Sc. Food Biotechnology. Remaining free slots will then be given to students enrolled in other M.Sc. degree programs.

## **Modul: Advanced Process Engineering Techniques for Cereal Processing (1509-500)**

Modulverantwortung	Prof. Dr. Bernd Hitzmann
Teilnahmevoraussetzungen	English language skills
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Wahl
Studienleistung	Passing the practical course
Modulprüfung	a written exam
Prüfungsdauer	60 Minuten
Arbeitsaufwand	56 h attendance + 132 h independent study = 188 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	<p>In the module advanced techniques and methods of the processing of cereals on their way to food will be presented. Process measurement, analysis, evaluation as well as optimization techniques will be discussed. After the module the participant knows:</p> <ul style="list-style-type: none"> <li>- Fundamentals of advanced process engineering techniques</li> <li>- The diversity of cereals as raw material</li> <li>- Milling, fermenting and baking techniques</li> <li>- Functional ingredients</li> <li>- Molecular reactions that occur during cereal processing,</li> </ul> <p>The advanced process analytics and monitoring methods (like NIR-, fluorescence spectroscopy, image analysis),  Different kinds of models to describe important processing steps,  Process optimization procedures.</p>

### **Advanced Process Engineering Techniques for Cereal Processing (1509-501)**



Person(en) verantwortlich	Prof. Dr. Bernd Hitzmann
Lehrform	Vorlesung mit Exkursion und Praktikum
SWS	4
Inhalt	In the module advanced techniques and methods of the processing of cereals on their way to food will be presented. The topics are : -Process analysis technology of cereal processing, -Breeding and growing aspects, -Storage, cleaning and milling techniques, -Cereal products, -Functional ingredients and molecular reactions, -NIR-, fluorescence, image analysis, -Mixing, kneading, proving, baking techniques -Modeling techniques of processing steps
Literatur	Burns, D.A.; Ciurczak, E.W.: Handbook of Near-Infrared Analysis, CRC Press, Boca Raton, 2008; Cauvain, S.P.: Bread making, Woodhead Publishing Limited, Cambridge 2003; Gobbetti, M.; Gänzle, M. (Eds.): Handbook on Sourdough Biotechnology, Springer, New York, 2013; MacRitchie, F.: Concepts in Cereal Chemistry, CRC Press, Boca Raton, 2010

## **Modul: Analysis and Quality Assurance in the Food Production (1504-500)**

Modulverantwortung	Prof. Dr. Herbert Schmidt
Bezug zu anderen Modulen	Module "Chemische Prinzipien der Lebensmittelverarbeitung" (1504-220)
Teilnahmevoraussetzungen	Good scientific basics in organic chemistry, laboratory practice
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	1. Semester
Dauer des Moduls	4 Wochen (Block 1)
Verbindlichkeit	Pflicht
Studienleistung	Regular attendance, analytical reports
Modulprüfung	Exam, colloquium
Prüfungsdauer	120 Minuten
Arbeitsaufwand	56 h attendance + 132 h independent study = 188 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	Students acquire knowledge on food analytical methods commonly used for quality control during food processing. Reaction mechanisms being essential for the understanding of the corresponding analytical methods, will be studied in detail. Students

	will acquire advanced laboratory skills, and analytical data obtained will be evaluated with regard to the processing technology.
<b>Theoretical Introduction to the Practical „Analysis and Quality Assurance in Food Production“ (1504-501)</b>	
Person(en) verantwortlich	Prof. Dr. Herbert Schmidt
Person(en) begleitend	Dr. rer. nat. Sybille Neidhart
Lehrform	Praktikum
SWS	1
Inhalt	Students acquire knowledge on food analytical methods, which are being used for quality control during food processing. Reaction mechanisms, which are essential for understanding of the corresponding analytical methods, will be studied in detail.
Literatur	Notes with recommendations for further literature will be distributed.
<b>Analysis and Quality Assurance in the Food Production (1504-502)</b>	
Person(en) verantwortlich	Prof. Dr. rer. nat. Dr. h.c. Reinhold Carle
Person(en) begleitend	Dr. rer. nat. Ralf Schweiggert
Lehrform	Praktikum
SWS	3
Inhalt	The students will acquire knowledge on instrumental, chemical, and enzymatic analyses on major and minor food constituents, e.g., lipids, proteins, carbohydrates, water, minerals, vitamins, secondary plant metabolites and others. Students will acquire advanced laboratory skills, and analytical data obtained will be evaluated with regard to the processing technology.

## **Modul: Anwendung von Bakteriophagen in den Lebenswissenschaften (1501-510)**

Modulverantwortung	Prof. Dr. Herbert Schmidt
Teilnahmevoraussetzungen	Bachelorabschluß in einem naturwissenschaftlichen Studiengang der Life Sciences / Gute mikrobiologische Kenntnisse
Sprache	deutsch/englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	geblockt
Verbindlichkeit	Wahl
Studienleistung	-

Prüfungsleistung	Protokoll, Referat/Vortrag/Präsentation
Modulprüfung	Protokoll/ Vortrag
Prüfungsdauer	45 Minuten
Arbeitsaufwand	100 h Präsenzzeit + 125 h Eigenanteil = 225 h Arbeitsaufwand
Fachkompetenzen / Lern- und Qualifikationsziele	<p>Ziel des Moduls ist, dass die Studierenden nach dessen Abschluss in der Lage sind,</p> <ul style="list-style-type: none"> <li>- grundlegende Prinzipien der Struktur und Vermehrungszyklen von Bakteriophagen zu erklären</li> <li>- verschiedene Anwendungsprinzipien für Bakteriophagen in den Life Sciences darzulegen</li> <li>- biotechnologische Vorträge und Originalpublikationen zu konzipieren, erstellen und diskutieren</li> <li>- neue experimentelle, analytische Methoden aus dem Bereich Biotechnologie/Mikrobiologie/Lebensmittelwissenschaft zu erörtern und anzuwenden</li> <li>- praktische Laborversuche im Bereich der Anwendung und Inaktivierung von Phagen durch zu führen.</li> <li>- hochtitrige Phagenlysate von E. coli und Bacillus cereus, rekombinante Expression von Phagenproteinen, Phagentransduktion, Induktion phagenkodierter Gene, Phageninaktivierung, Verkapselung von Bakteriophagen herzustellen.</li> <li>- fachgebietsspezifische Einblicke in die Vermeidung von Phageninfektionen und Anwendung der Phagen zu diskutieren</li> <li>- die bioinformatische Analyse von Phagengenomen anzuwenden</li> </ul>
Schlüsselkompetenzen	<p>Ziel des Moduls ist, dass die Studierenden nach dessen Abschluss in der Lage sind, - Selbständig zu arbeiten und sich Wissen anzueignen</p> <ul style="list-style-type: none"> <li>- Fachliteratur kritisch zu lesen und zu diskutieren</li> <li>- Fachbegriffe richtig anzuwenden</li> <li>- Wissenschaftliche Ausdrucksweise anzuwenden</li> <li>- Laborversuche selbständig zu planen durchzuführen und auszuwerten</li> <li>- Eigene Ergebnisse vor dem Hintergrund der wiss. Literatur zu evaluieren</li> <li>- Das erlernte Wissen auch fachübergreifend zum Einsatz bringen</li> <li>- Kommunikations- und Kooperationsfähigkeit anzuwenden</li> </ul>
Anmerkungen	Anzahl Teilnehmerplätze: 8 Anmeldung zum Modul: über Ilias Anmeldezeitraum: siehe Modulkatalog Kriterien, nach denen Studienplätze vergeben werden: Anmeldung im Anmeldezeitraum, Studiengangszugehörigkeit
<b>Anwendung von Bakteriophagen in den Lebenswissenschaften (1501-511)</b>	
Person(en) verantwortlich	Prof. Dr. Herbert Schmidt, Prof. Dr. rer. nat. Andreas Kuhn, Prof. Dr.-Ing. habil. Jörg Hinrichs, PD Dr. med. vet. habil. Wolfgang Beyer, Prof. Dr. med. vet. Ludwig E. Hölzle, Prof. Dr. Martin Hasselmann
Lehrform	Vorlesung mit Seminar und Laborübungen
SWS	6
Inhalt	<ul style="list-style-type: none"> <li>- Grundlagen der Struktur und Physiologie von Bakteriophagen</li> <li>- Ausgewählte Bakteriophagen und ihre Wirte</li> </ul>

	<ul style="list-style-type: none"> <li>- Molekularbiologische Untersuchungen zur Assemblierung von Phagen</li> <li>- Anwendung und Kontrolle von Bakteriophagen in der Milchtechnologie</li> <li>- Bakteriophagen von bakteriellen Krankheitserregern (E. coli, Bacillus spp.)</li> <li>- Anwendung von Phagen in der Biotechnologie</li> </ul>
Literatur	<p>Phages. Their Role in Bacterial Pathogenesis and Biotechnology. 2005. Waldor, Friedman, and Adjya, Eds. ASM Press, Washington, USA</p> <p>Bakterienviren. 1992. Klaus, Krüger, Meyer Hrsg. Gustav Fischer Verlag, Jena</p>

## Modul: Applied Mathematics for the Life Sciences (1101-400)

Modulverantwortung	Prof. Dr. Philipp Kügler
Teilnahmevoraussetzungen	Knowledge of the contents of the modul "Mathematik für Biowissenschaften" as part of the B.Sc.-programme "Lebensmittelwissenschaft und Biotechnologie" at the University of Hohenheim.
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	1. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Pflicht
Studienleistung	Regular attendance and active software programming
Modulprüfung	written exam
Prüfungsdauer	120 Minuten
Arbeitsaufwand	84 h attendance + 106 independent study = 190 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	Students will learn the basic principles of modeling and simulation with ordinary and partial differential equations in the life sciences. They will be able to classify and formulate mathematical models of processes in food engineering and earth system sciences and use the software packages MATLAB and COMSOL to implement and numerically analyze them. Furthermore, students will know central concepts of model parameter identification from experimental data.
Anmerkungen	Maximum number of participants: 50
<b>Applied Mathematics for the Life Sciences, Lecture and Exercise (1101-401)</b>	

Person(en) verantwortlich	Prof. Dr. Philipp Kügler
Person(en) begleitend	Heiko Schulz, Dr. André Erhardt
Lehrform	Vorlesung mit Übung
SWS	6
Inhalt	Linear and nonlinear ordinary differential equations Systems of ordinary differential equations Initial and boundary value problems Numerical Integration Finite difference method Finite element method Partial differential equations Parameter identification problems Control of differential equations
Literatur	

## **Modul: Applied Mathematics for the Life Sciences II (1101-410)**

Modulverantwortung	Prof. Dr. Philipp Kügler
Bezug zu anderen Modulen	Builds on the module "Applied Mathematics for the Life Sciences (1101-400)"
Teilnahmevoraussetzungen	Successful completion of the module "Applied Mathematics for the Life Sciences (1101-400)" and knowledge in Matlab
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Wahl
Studienleistung	Active participation in the lecture and exercise
Modulprüfung	Written exam
Prüfungsdauer	120 Minuten
Arbeitsaufwand	84 h attendance + 106 h independent study = 190 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	Upon completion of the module students are able to: - classify and numerically solve common partial differential equations, - formulate optimization tasks and solve them numerically, - use simulation software.
Schlüsselkompetenzen	Upon completion of the module students are able to: - independently solve simple simulation tasks in research and

	development,\r\n- enter a dialogue with simulation experts in the context of interdisciplinary cooperation,\r\n- analyze scientific problems in a structured manner.
<b>Applied Mathematics for the Life Sciences II (1101-411)</b>	
Person(en) verantwortlich	Prof. Dr. Philipp Kügler
Lehrform	Vorlesung mit Übung
SWS	6
Inhalt	<ul style="list-style-type: none"> <li>- classification of partial differential equations</li> <li>- finite difference method and finite element method</li> <li>- classification of optimization tasks</li> <li>- ways to solve constant optimization problems</li> <li>- control and parameter identification tasks</li> </ul>
Literatur	<p>M.S. Gockenbach, Partial Differential Equations: Analytical and Numerical Methods, SIAM, Philadelphia, 2010</p> <p>R.J LeVeque, Finite Difference Methods for Ordinary and Partial Differential Equations, SIAM, 2007</p> <p>L. Edsberg, Introduction to Computation and Modeling for Differential Equations, Wiley, 2008</p>

## **Modul: Bioethanol and Distilled Spirits (1506-500)**

Modulverantwortung	Prof. Dr. Ralf Kölling-Paternoga
Teilnahmevoraussetzungen	-
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 4)
Verbindlichkeit	Wahl
Studienleistung	Regular attendance and active participation. Practical report.
Modulprüfung	Written exam
Prüfungsdauer	120 Minuten
Arbeitsaufwand	70 h attendance + 118 h independent study = 188 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	On successful completion of the module you are familiar with the basic concepts of bioethanol and distilled spirits production. You are acquainted with the raw materials used in ethanol production. You know the methods and procedures used to convert the sugar present in the raw materials into ethanol and you have learned to

	<p>apply this theoretical knowledge in practice. Furthermore, you know how some of the popular distilled spirits are made.</p> <p>You improved your skills in recognizing problems in the manufacturing process of food or beverages and to find goal-oriented solutions to these problems. You enhanced your understanding of the basic concepts in food technology and learned how to apply these concepts in practice.</p>
Anmerkungen	Maximum number of participants: 20
<b>Bioethanol and Distilled Spirits, Lecture (1506-501)</b>	
Person(en) verantwortlich	Prof. Dr. Ralf Kölling-Paternoga
Person(en) begleitend	Dr. Daniel Einfalt
Lehrform	Vorlesung
SWS	2
Inhalt	In the lecture, the different steps in the manufacturing process of fermentation ethanol from feedstock preparation to mashing process, fermentation and distillation are presented. The different feedstocks are discussed with respect to their properties and suitability for ethanol production. Also, the production process of some popular distilled spirits will be examined in detail. In addition, we talk about the basics of sensory testing of distilled spirits.
Anmerkungen	Alcohol Textbook, Lyons, Kelsall, Murtagh (Eds.), Nottingham University Press (2004) Sprituosen-Technologie, Kolb, Behr Verlag (2004) The Biotechnology of Ethanol, Rohr (Ed.), Wiley-VCH (2001)
<b>Bioethanol and Distilled Spirits, Seminar (1506-502)</b>	
Person(en) verantwortlich	Prof. Dr. Ralf Kölling-Paternoga
Person(en) begleitend	Dr. Daniel Einfalt
Lehrform	Seminar
SWS	1
Inhalt	In the seminar, you will deepen certain aspects brought up in the lecture, like e.g. specific problems with different feedstocks in starch to sugar conversion. You learn about herbal drugs used in distilled spirits production. You practice alcoholometric calculations. Finally, you will apply your sensory expertise acquired in the lecture to organoleptic testing of whiskies.
<b>Bioethanol and Distilled Spirits, Practical (1506-503)</b>	
Person(en) verantwortlich	Prof. Dr. Ralf Kölling-Paternoga
Person(en) begleitend	Dr. Daniel Einfalt
Lehrform	Praktikum

SWS	2
Inhalt	In the practical, you will put your theoretical knowledge gained in the lecture into practice. You will perform the mashing process of starchy feedstock in lab scale and pilot plant scale at our university distillery and analyze the process parameters. You will examine in detail the distillation process on our 48-stage rectification column. You will make use of fractioned distillation on a "birectificator" to evaluate the quality of different cognacs or brandies.

## **Modul: Biologie des Alterns und die Rolle der Ernährung (1403-430)**

Modulverantwortung	Prof. Dr. Jan Frank
Teilnahmevoraussetzungen	B. Sc. Ausbildung mit Toxikologie, Biofunktionalität, Biochemie o.ä.
Sprache	deutsch/englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Wahl
Modulprüfung	Klausur
Prüfungsdauer	60 Minuten
Arbeitsaufwand	56 h Präsenz + 154 h Eigenanteil = 210 workload
Fachkompetenzen / Lern- und Qualifikationsziele	Die Studierenden\r\n- verstehen die Grundlagen des Alterungsprozesses.\r\n- verstehen den Pathomechanismus altersbedingter Erkrankungen.\r\n- verstehen die Potentiale und Grenzen von Ernährungsinterventionen in den Alterungsprozess und die Pathophysiologie altersbedingter Erkrankungen.
Anmerkungen	Anmeldung zur Teilnahme am Modul: Über ILIAS bis spätestens vier Wochen vor Modulbeginn

### **Biologie des Alterns und die Rolle der Ernährung (1403-431)**

Person(en) verantwortlich	Prof. Dr. Jan Frank
Lehrform	Vorlesung
SWS	4
Inhalt	<ul style="list-style-type: none"> <li>- Mechanistische Veränderungen im Alterungsprozess</li> <li>- Soziale, demographische Veränderungen im Alter</li> <li>- Altern und Ernährung (Versorgungslage, Intervention)</li> <li>- Pathophysiologie ausgewählter Erkrankungen</li> <li>- Rolle der Versorgung mit Nährstoffen und Mikronährstoffen in der Pathologie</li> </ul>



Literatur	Aging: Facts and Theories (Interdisciplinary Topics in Gerontology) Robert, L., Fulop, T. (Karger) 2014 Masoro, Austad: Handbook of the Biology of Aging, Academic Press, 2001

## Modul: Cellular Microbiology (2502-430)

Modulverantwortung	Prof. Dr. Julia Fritz-Steuber
Teilnahmevoraussetzungen	-
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Wahl
Studienleistung	Regular and active participation
Modulprüfung	Oral presentation and protocol
Arbeitsaufwand	56 h presence + 169 h personal contribution = 225 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	The students know different strategies of bacterial pathogens to manipulate the host. They understand the mechanism of action of virulence factors on a molecular level. They understand the importance of environmental factors for the morphology of a bacterial cell, for example during biofilm formation
Schlüsselkompetenzen	The students are encouraged to work as independent as possible in a team solving a current problem in research. They analyse their data and discuss their results with respect to existing theories in the field. They write a scientific report of their research project according to the rules for scientific writing. They present their results in a lecture.
Anmerkungen	Maximum number of participants: 6 Registration for participation: from March 18 to April 5 via ILIAS

### Cellular Microbiology, Lecture (2502-431)

Person(en) verantwortlich	Prof. Dr. Julia Fritz-Steuber
Lehrform	Vorlesung
SWS	1
Inhalt	The students know different strategies of bacterial pathogens to manipulate the host. They understand the mechanism of action of virulence factors on a molecular level. They understand the importance of environmental factors for the morphology of a bacterial cell, for example during biofilm formation.

Literatur	Michael Wilson, Rod McNab, Brian Henderson: "Bacterial Disease Mechanisms: An Introduction to Cellular Microbiology", Cambridge University Press, 2002 Pascale Cossart, Patrice Boquet, Staffan Normark, Rino Rappuoli: "Cellular Microbiology", ASM Press, 2004
Anmerkungen	Maximum of 6 participants   Requirement for participation: Regular and active participation of the course "Cellular Microbiology, Research Internship" (2502-432)
<b>Cellular Microbiology, Research Internship (2502-432)</b>	
Person(en) verantwortlich	Prof. Dr. Julia Fritz-Steuber
Lehrform	Praktikum
SWS	3
Inhalt	The students are encouraged to work as independent as possible in a team solving a current problem in research. They analyse their data and discuss their results with respect to existing theories in the field. They write a scientific report of their research project according to the rules for scientific writing. They present their results in a lecture.
Literatur	Kathleen McMillan, Jonathan Weyers: "How to Write Dissertations & Project Reports" Pearson Education, 2007
Anmerkungen	Maximum of 6 participants   Requirement for participation: Regular and active participation of the course "Cellular Microbiology, Lecture" (2502-431)

## Modul: Cellular Signalling (1402-450)

Modulverantwortung	Prof. Dr. Lutz Graeve
Teilnahmevoraussetzungen	-
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Wahl
Studienleistung	Inquest and compiling cytokine profiles for a database
Modulprüfung	Written exam
Prüfungsdauer	90 Minuten
Arbeitsaufwand	56 h presence + 132 h personal contribution = 188 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	After this module the students are able to

	<ul style="list-style-type: none"> <li>- describe the mechanisms of proliferation, differentiation and apoptosis.</li> <li>- understand the significance of different cellular signalling cascades for these processes.</li> <li>- have extensive knowledge about the different components of signalling cascades.</li> <li>- analyse pathophysiological consequences of malfunctioning signalling pathways.</li> <li>- understand in which ways nutrition is able to interfere with these complex processes.</li> </ul>
Schlüsselkompetenzen	After this module the students are able to - discuss the regulation of the homeostasis of the human body by hormones, cytokines and growth factors in health and disease and to grasp the complexity of this regulatory network. - evaluate the possible input of "omics" technologies and bioinformatics in these scenarios. - apply this knowledge in the appraisal of problems of human nutrition and health.
Anmerkungen	Maximum number of participants: 30 Registration for participation: via ILIAS
<b>Biochemistry of Signal Transduction (1402-451)</b>	
Person(en) verantwortlich	Prof. Dr. Lutz Graeve
Lehrform	Vorlesung
SWS	2
Inhalt	<ul style="list-style-type: none"> <li>- Proliferation, differentiation and apoptosis</li> <li>- Ligands, receptors, G-Proteins, second messenger</li> <li>- Kinases</li> <li>- Cellular signal cascades</li> <li>- Adipokines</li> <li>- Nutrient signalling</li> </ul>
Literatur	Heinrich, Müller, Graeve Hrsg.: Löffler/Petrides Biochemie und Pathobiochemie Gomperts: Signal transduction Krauss: Biochemistry of Signal Transduction and Regulation
<b>Mediators of Regulation in Health, Disease and Nutrition (1402-452)</b>	
Person(en) verantwortlich	Prof. Dr. Lutz Graeve
Lehrform	Seminar
SWS	2
Inhalt	Updating and extension of a cytokine database, short presentations
Literatur	Recent reviews on the topic
Anmerkungen	This course is suitable for international students with competencies in human biology and nutrition

## Modul: Dairy Science and Technology (1505-440)

Modulverantwortung	Prof. Dr.-Ing. habil. Jörg Hinrichs
Teilnahmevoraussetzungen	-
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Wahl
Prüfungsleistung	Exam (70 % of total), practical seminar (30% of total)
Modulprüfung	Written (120 minutes) or oral (20 minutes) exam
Prüfungsdauer	120 Minuten
Arbeitsaufwand	70 h attendance + 108 h independent study = 188 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	<p>The aim of the course is to learn about the physical and chemical properties of milk ingredients and their processing characteristics. The relationships between raw material processing technology and product characteristics are introduced. It also teaches the concept of mass and energy balances, the estimation of the microbial risk of dairy products and the hazards associated with the various processing steps.</p> <p>The students develop their ability to work independently through practical work. At the same time, they are expected to work in teams for some exercises. They also gain problem solving skills in these tasks.</p>
Anmerkungen	Maximum number of participants: 25
<b>Dairy Science and Technology (1505-441)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. habil. Jörg Hinrichs
Lehrform	Vorlesung mit Übung, Praktikum und Exkursion
SWS	5
Inhalt	<ul style="list-style-type: none"> <li>- Physics and chemistry of milk components</li> <li>- Analytical tools</li> <li>- Hygiene and aseptic</li> <li>- Evaporation to milk concentrate</li> <li>- Membrane filtration to fractionate milk</li> <li>- Milk powder production technology &amp; application aspects</li> <li>- Milk desserts and foams</li> </ul>

Literatur	Kessler, H.G., Food & Bio Process Engineering – Dairy Technology, A. Kessler, München, 2011. Hinrichs, J., Lecture notes Palzer, S., Lecture notes
Anmerkungen	A one-day excursion is part of this module.

## **Modul: Drying, Granulation and Instantisation (1503-540)**

Modulverantwortung	Prof. Dr.-Ing. Reinhard Kohlus
Teilnahmevoraussetzungen	Knowledge of equivalent to Food Process Design I, e.g. Basics of fluid mechanics, mass and heat transfer, unit operations in food processing.
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 4)
Verbindlichkeit	Wahl
Modulprüfung	Written exam (60 minutes), oral exam (30 minutes).
Arbeitsaufwand	56 h attendance + 154 h independent study = 210 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	The students will learn to model drying problems. Starting at the physical basics of drying up to equipment design.  They know key quality parameter and degradation mechanism for dry / low aw food.  The learned skills focus on applicable knowledge which is based on strong basic / theoretical foundations allowing to apply it in a wide context.  The application of computer based methods is trained by working on application case studies.
Schlüsselkompetenzen	Key competencies addressed in this module are critical problem assessment and analytical thinking.
Anmerkungen	Maximum number of participants: 20 Registration via ILIAS until 2 weeks before the course starts.

### **Drying, Granulation and Instantisation, Lecture (1503-541)**

Person(en) verantwortlich	Prof. Dr.-Ing. Reinhard Kohlus
Person(en) begleitend	Dr. Martin Spraul
Lehrform	Vorlesung
SWS	4

Inhalt	<p>Selection and lay out (dimensioning) of drying equipment for tasks in food processing. Scientific description of dryer, typical equipment used in food drying: i.e. spray dryer, belt drier, roller drier, freeze drier</p> <p>Analysis and modelling of temperature-moisture behaviour of foods. Fundamentals of Agglomeration / granulation. Design, Scale up and operation (Process lay out) of granulators and agglomerators (Fluid bed and High shear mixer).</p> <p>Computation of relevant problems related to dry food. Fundamental approach to problems in drying and dealing with low aw foods. Selected examples of recipe effects in drying and instantisation of food.</p> <p>Quality parameter of dry foods, interactions and storage effects. Characterisation, functionality and quality of food powders and related property functions, importance of amorphous state mechanism and parameter determining the quality of low aw food and their relation to the drying process.</p>
Literatur	<p>Trocknungstechnik in der Lebensmittelindustrie , Gehrman, Esper, Schuchmann, Behrs-Verlag 2009;</p> <p>Die wissenschaftlichen Grundlagen der Trocknungstechnik Band 1, , O. Krischer, W. Kast Springer Verlag 1992</p>
Anmerkungen	List of English literature will be provided at start of course

## **Modul: Encapsulation of Functional Food Components (1507-410)**

Modulverantwortung	Prof. Dr. Jochen Weiss
Teilnahmevoraussetzungen	Admission to a Master's program or the doctoral degree program at the Faculty of Natural Sciences. This module requires basic knowledge of food structures.
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (Block 3)
Verbindlichkeit	Wahl
Studienleistung	Präsentation: Laboratory work
Prüfungsleistung	Präsentation: Development project
Modulprüfung	Mündliche Prüfung (75% der Gesamtnote), Projekt und Präsentation über dieses Projekt (25% der Gesamtnote)
Prüfungsdauer	20 Minuten
Arbeitsaufwand	68 h attendance + 127 h independent study = 195 h workload

Fachkompetenzen / Lern- und Qualifikationsziele	Upon completion of the module, students are expected to have gained an overview of the importance of encapsulation, and encapsulants for applications in food and related fields. The students are able to demonstrate an understanding of (i) the physicochemical properties of functional ingredients, (ii) the fundamental physical and chemical processes governing the behavior and stability of the encapsulation systems, and (iii) principles of encapsulation technologies and key processing parameters, and apply this knowledge to encapsulation-related challenges. Furthermore, the students are able to explain, evaluate, and communicate their findings/solutions to their peers and professionals.
Schlüsselkompetenzen	Upon completion of the module, students are able to work as a part of a team, and develop stronger communication skills by completing assignments and designing clear and well-organized presentations. The students are expected to apply critical and analytical thinking to solve encapsulation-related challenges. Furthermore, the students are encouraged to demonstrate their critical and analytical thinking skills by asking critical questions during the student presentations. Students are able to improve their written and oral English skills.
Anmerkungen	Available places: 16 Registration: latest 2 weeks before the begin of the module Registration period (Anmeldezeitraum): at the beginning of semester (zu Semesterbeginn) Criteria for assigning available study places (Kriterien, nach denen Studienplätze vergeben werden): On first come, first-served basis.
<b>Encapsulation of Functional Food Components (1507-411)</b>	
Person(en) verantwortlich	Prof. Dr. Jochen Weiss
Person(en) begleitend	Dr. Benjamin Zeeb, Dr. rer. nat. Hanna Salminen, Dr. Thrandur Helgason
Lehrform	Seminar mit Übung
SWS	4
Inhalt	This module reviews the principles of encapsulation and aims to deliver knowledge of encapsulation systems and encapsulation processes. The goal of this module is to develop skills needed in encapsulating functional components in food or related industries. Industry-hosted lectures give insights into encapsulation from an industrial point-of-view. Student assignments aim to promote knowledge transfer and enable the students to apply scientific concepts and scientific literature. These assignments involve, for example, a literature-based development project and a laboratory study. Both assignments will be also orally presented during the module
Literatur	Encapsulation Technologies for Active Ingredients and Food Processing, Verlag Springer, Berlin, 2009, ISBN: 978-1441910073 Encapsulation and Controlled Release Technologies in Food Systems Blackwell Publishers, New York, 2007, ISBN: 978-0813828558 Encapsulation and Controlled Release

	Woodhead Publishers, New York, 1993, ISBN: 978-1855738201
Anmerkungen	Maximum number of participants: 16

## Modul: Enzymatic Reactions (1502-410)

Modulverantwortung	Prof. Dr. rer. nat. Lutz Fischer
Bezug zu anderen Modulen	The module is part of the series Enzyme Biotechnology .
Sprache	deutsch/englisch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 4)
Verbindlichkeit	Wahl
Studienleistung	Attendance and active participation in seminars and practical course, protocol
Prüfungsleistung	oral examinations are about the theory and results of the practical parts which will be presented by the student in seminars
Modulprüfung	oral examinations (50%), protocol (50%)
Prüfungsdauer	30 Minuten
Arbeitsaufwand	90 h attendance + 135 h independent study = 225 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	Upon completion students are able to determine the enzyme activity of different kinds of enzymes. In addition, students are able to plan, perform and evaluate scientific experiments to characterize enzymes using different biochemical methods on their own. The students are able to plan and perform a gene transformation and express an enzyme recombinantly in a microorganism.
Schlüsselkompetenzen	The aim of this module is that students are able to plan and work in a laboratory independently. They will be able to interpret their results and to compare them with known data from literature. In addition, they will be able to present their results in front of an audience.
Anmerkungen	Mindestteilnehmerzahl: 6 Anzahl Plätze: 12 Registration: ILIAS
<b>Enzymatic Reactions   Lectures and Seminar (1502-411)</b>	
Person(en) verantwortlich	Prof. Dr. rer. nat. Lutz Fischer
Person(en) begleitend	Dr. rer. nat. Sabine Lutz-Wahl, Priv. Doz. Dr. rer. nat. Timo Stressler, Dr. rer. nat. Ines Seitzl, Paul Swietalski, Katrin Reichenberger, Lucas Kettner
Lehrform	Vorlesung mit Seminar
SWS	1.5



Inhalt	<p>Students will learn the theoretical backgrounds for enzyme activity determination, enzyme process development and they will gain knowledge about enzyme applications in the industry. The students will learn to examine and use current scientific literature about certain enzyme classes.</p> <p>Key words:</p> <ul style="list-style-type: none"> <li>- Screening for suitable and/or new enzymes</li> <li>- Enzymes in non-conventional media</li> <li>- Enzymes modified by bioimprinting methodology</li> <li>- Immobilisation of biocatalysts</li> <li>- HPLC and CGC Analysis to quantify enzyme activities</li> </ul> <p>Besides the students will present their own results, evaluate and discuss them (will be marked).</p>
Literatur	<p>Current original papers about enzymes, text books for laboratory work, General Literatur:</p> <p>Bisswanger, H.: Practical Enzymology, 2. ed., Wiley-Blackwell          Buchholz, K., Kasche V., Bornscheuer U.: Biocatalysts and Enzyme Technology, 2. ed., Wiley-Blackwell</p> <p>Current scientific publications (will be provided)</p>

### **Enzymatic Reactions | Practical course (1502-412)**

Person(en) verantwortlich	Prof. Dr. rer. nat. Lutz Fischer
Person(en) begleitend	Paul Swietalski, Katrin Reichenberger, Lucas Kettner, Ina Schirin Bußler
Lehrform	Praktikum
SWS	6
Inhalt	<p>Students will learn to apply knowledge from the literature and text books by itself. By doing so, They will learn to determine the enzyme activity of a particular enzyme class with suitable methods. In addition, the enzymes will be partly characterized biochemically (e.g. pH-profile, temperature profile, inhibitors,...).</p>
Literatur	<p>Current literature about particular enzyme classes, original articles and reviews (will be discussed with supervisor)</p> <p>General text books:</p> <p>Bisswanger, H.: Practical Enzymology, 2. ed., Wiley-Blackwell</p> <p>Buchholz, K., Kasche V., Bornscheuer U.: Biocatalysts and Enzyme Technology, 2. ed., Wiley-Blackwell</p>

### **Modul: Fermentation Technology (1502-430)**

Modulverantwortung	Prof. Dr. rer. nat. Lutz Fischer
Teilnahmevoraussetzungen	-
Sprache	englisch

ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Wahl
Studienleistung	Lab book - Attendance on lectures, seminars and lab experiments -
Modulprüfung	Protocol (40%), Presentation of Results and Oral Exam (60%)
Prüfungsdauer	30 Minuten
Arbeitsaufwand	90 h attendance + 135 h independent study = 225 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	After this modul, the students have knowledge about the fundamtel requirments for a cultivation of microorganims. This includes the composition of complex and defined media as well as of submers and solid state fermenters. Additionally, the students know about the measuring principle of pH-electrodes, oxygen and exhaust gas measurment devices. Upon completion of this modul, the students are able to plan and conduct suberms cultivations of microorganisms in shaking flasks and a bioreactor. Also the students are able to conduct a solid-state fermentation. After this modul the students can evaluate cultivations of microorganims in view of fundamental requirements like yield, biomass, growth rate etc.. They have knowledge about microorganisms and processing of diverse fermented foods.
Schlüsselkompetenzen	Upon completion of this module the students are able to plan and work in a laboratory independently. They will be able to interpret their results and to compare them with known data from literature. In addition, they will be able to present and discuss their results in front of an audience.
Anmerkungen	Maximum number of participants: 24
<b>Fermentation Technology, Lecture with Exercise (1502-431)</b>	
Person(en) verantwortlich	Prof. Dr. rer. nat. Lutz Fischer
Person(en) begleitend	Dr. rer. nat. Sabine Lutz-Wahl, Dipl.-Ing. (FH) Wolfgang Claaßen
Lehrform	Vorlesung mit Praktikum
SWS	4
Inhalt	In interactive lessons the students will learn the preparation and composition of differnet culture media, the assembly of the bioreactor and sterile sampling during cultivation. Also the analysing of samples will be understood, planned, performed and evaluated. The theoretical background for planning, performing and analysing batch-cultivations will be discussed and exercised in the practical course.  The students will be able to cultivate bacteria and yeasts in shaking flask and bioreactor (1 L; 30 L scale). Important biotechnological parameters such as oxygen transfer (K <sub>la</sub> ), biomass yields, product

	yields, enzyme activities and C-source consumption will be discussed and evaluated. Also, the students will be able to cultivate microorganisms using the solid-state principle.
Literatur	Principles of Fermentation Technology (2nd edition), Edts. Stanbury, Whitaker and Hall, 1999, Reed Educational and Professional Publishing Ltd. Manual of Industrial Microbiology and Biotechnology, Edts. Demain and Davies, 1999, ASM Press

## **Modul: Food Process Design I - Efficient Processing and Transport Phenomena (1503-520)**

Modulverantwortung	Prof. Dr.-Ing. Reinhard Kohlus
Teilnahmevoraussetzungen	Technical basics, process engineering, physical chemistry or thermodynamics of multiphase systems
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	1. Semester
Dauer des Moduls	4 Wochen (Block 3)
Verbindlichkeit	Pflicht
Arbeitsaufwand	80 h attendance + 130 h independent study = 210 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	The students know the fundamentals of thermal separation processes. They are capable of applying physical-chemistry fundamentals, to design the processes.  The laws of energy and mass and momentum transfer are known and can be applied to standard problems.  The fundamental calculation methods are mastered.
Anmerkungen	Maximum number of participants: 50
<b>Food Process Design I - Efficient Processing and Transport Phenomena, Lecture (1503-521)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. Reinhard Kohlus
Lehrform	Vorlesung
SWS	3
Inhalt	Application of the fundamentals of thermal separation processes, multiphase flow and food process design. Specifically covered topics are drying technology, distillation and rectification, extraction, crystallization, heat transfer processes.

	<p>Fundamentals: Equilibria equations, Phase and state diagrams, mass transfer equations,</p> <p>Multiphase flows: especially gas –liquid flows, Mass transfer in multiphase systems, two film theory, surface renewance theory</p> <p>Design of rectification system: McCabe Thiele Diagram, hydrodynamic design of rectification columns.</p> <p>Description of residence time distributions, prediction of RTD's</p> <p>Drying, coupling of heat and mass transfer, Glass transition temperature, sorp-tion isotherms.</p> <p>Optimisation of energy requirements, coupling of heat flows- Design and decision taking of heat transfer systems.</p>
Literatur	<p>Sattler; Thermische Trennverfahren; VCH Verlag</p> <p>Kraume, M: Transportvorgänge in der Verfahrenstechnik, Grundlagen und Apparative Umsetzung , Springer Verlag 2004</p>
<p><b>Food Process Design I - Efficient Processing and Transport Phenomena, Exercise (1503-522)</b></p>	
Person(en) verantwortlich	Prof. Dr.-Ing. Reinhard Kohlus
Person(en) begleitend	Dr.-Ing. Peter Gschwind
Lehrform	Übung
SWS	2
Inhalt	<p>Application of the fundamentals of thermal separation processes, multiphase flow and food process design. Specifically covered topics are drying technology, distillation and rectification, extraction, crystallization, heat transfer processes.</p> <p>Fundamentals: Equilibria equations, Phase and state diagrams, mass transfer equations,</p> <p>Multiphase flows: especially gas –liquid flows, Mass transfer in multiphase systems, two film theory, surface renewance theory</p> <p>Design of rectification system: McCabe Thiele Diagram, hydrodynamic design of rectification columns.</p> <p>Description of residence time distributions, prediction of RTD's</p> <p>Drying, coupling of heat and mass transfer, Glass transition temperature, sorp-tion isotherms.</p> <p>Optimisation of energy requirements, coupling of heat flows- Design and decision taking of heat transfer systems.</p> <p>Exercises and problems in the above given areas will be covered using calcu-lation and engineering software.</p>

Literatur	Sattler; Thermische Trennverfahren; VCH Verlag Kraume, M: Transportvorgänge in der Verfahrenstechnik, Grundlagen und Apparative Umsetzung , Springer Verlag 2004
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## **Modul: Food Process Design II - Process Integration and Scale up (1503-500)**

Modulverantwortung	Prof. Dr.-Ing. Reinhard Kohlus
Teilnahmevoraussetzungen	Knowledge of equivalent to Food Process Design I, e.g. Basics of fluid mechanics, mass and heat transfer, unit operations in food processing.
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 3)
Verbindlichkeit	Wahl
Modulprüfung	Written or oral exam depending on the number of participants.
Prüfungsdauer	120 Minuten
Arbeitsaufwand	56 h attendance + 154 h independent study = 210 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	<p>The students will learn to structure a line design problem and place it in the economical context. They will be able to make a systematic construction based on the main process-product interactions. They know the principles of the design of experiment approach and can apply these to a process design question. The students are able to solve scale up problems by principles of similitude.</p> <p>The learned skills focus on applicable knowledge which is based on strong basic / theoretical foundations allowing to apply it in a wide context.</p> <p>A key skill needed in this context is the ability to combine the set of tools to appropriately tackle a complex process design problem.</p>
Schlüsselkompetenzen	Key competencies addressed in this module are threefold: decision making and dealing with complexity, understanding different roles in project management and team work and lastly professional communication with business partner.
Anmerkungen	Maximum number of participants: 24 Registration via ILIAS
<b>Food Process Design II – Process Integration and Scale up, Lecture and Exercise (1503-501)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. Reinhard Kohlus

Lehrform	Vorlesung mit Übung
SWS	4
Inhalt	Set-up of requirement lists, systematic construction processes (i.e. conceptual process design), apparatus and plant engineering and construction, Process-product interactions, Robust plant design, Process scale up, Design of experiments for process modelling. Hygienic design rules and cleaning considerations (cip, wip, sip), process control strategies and process optimization.
Literatur	Blass, E.; Entwicklung Verfahrenstechnischer Prozesse; Springer, Berlin (1997) Zlokarnik, M.; Scale up ; WILEY-VCH Verlag GmbH (2005) Kleppmann, W.; Taschenbuch Versuchsplanung; Hanser Verlag 2008 Douglas, J.,M. ; Conceptual Design of Chemical Prozesses; Mac GrawHill, Boston 1976 Hauser, G.; Hygienische Produktgestaltung; WILEY-VCH Verlag GmbH (2007)
Anmerkungen	List of English literature will be provided at start of course

## Modul: Free Project Work (1500-020)

Modulverantwortung	Prof. Dr. rer. nat. Lutz Fischer
Teilnahmevoraussetzungen	M.Sc. Food Biotechnology
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes Semester
Semesterlage	2. Semester
Dauer des Moduls	n. V.
Verbindlichkeit	Wahl
Prüfungsleistung	Report (50%) and Presentation (50%)
Modulprüfung	Report and Presentation
Prüfungsdauer	30 Minuten
Arbeitsaufwand	210 h
Fachkompetenzen / Lern- und Qualifikationsziele	Upon completion of this module students - have gained insight into a current research project - understand the theoretical foundation and methodology of the research project - acquire practical experience by employing the methodology - learn how to properly document research findings - acquire experience in presenting research findings orally

Anmerkungen	Maximum number of participants: 3 Students have to find a professor to supervise the project.
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## Modul: Innovative Milchtechnologie (1505-420)

Modulverantwortung	Prof. Dr.-Ing. habil. Jörg Hinrichs
Bezug zu anderen Modulen	Milchwissenschaft und -technologie, Rheologie und Struktur von Lebensmitteln, Projektarbeit
Teilnahmevoraussetzungen	Technische, physikalische, chemische und mikrobiologische Grundlagen der Lebensmittel- und Biotechnologie; Besuch der Vorlesung "Milchwissenschaft und Technologie"
Sprache	deutsch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	3. Semester
Dauer des Moduls	geblockt
Verbindlichkeit	Wahl
Studienleistung	Regelmäßige und aktive Teilnahme, Bearbeitung eines Themas
Modulprüfung	Ausarbeitung zum vergebenen Thema - nicht benotet
Arbeitsaufwand	80 h Präsenz + 130 h Eigenanteil = 210 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	<p>Die Studierenden</p> <ul style="list-style-type: none"> <li>- sind in der Lage die chemisch-physikalischen Eigenschaften der Milch Inhaltsstoffe sowie die mikrobiologischen Rahmenbedingungen im Hinblick auf Neues einzuordnen und zu bewerten</li> <li>- überblicken mikrobiologische Risiken für Produkte und können daraufhin Forschungs- und Entwicklungsprojekte evaluieren</li> <li>- besitzen Kompetenz zum Einsatz von Unit-Operations für innovative Milch und Milchprodukte</li> <li>- haben Kompetenz in der Auswahl physikalischer, chemischer und mikrobiologischer Methoden zur quantitativen oder qualitativen Beurteilung von Zielgrößen in Milchmatrices oder in Bezug auf einzelne Inhaltsstoffe</li> <li>- sind in der Lage in einem Team Potenziale für neue Prozesse oder Produkte im Bereich Milch nach wissenschaftlichen Gesichtspunkten zu eruieren, dafür Hypothesen zu formulieren und Bearbeitungswege auszuarbeiten</li> <li>- sind in der Lage kurz und prägnant daraus abgeleitete Forschungs- und Entwicklungsideen im Team schriftlich zusammen zu stellen, zu diskutieren und zu präsentieren.</li> </ul>
Anmerkungen	Das Modul findet ab einer Teilnehmerzahl von 10 Studierenden und mit maximal 20 Studierenden statt. Anmeldung zur Teilnahme am Modul: ILIAS und Aushang bis eine Woche vor Modulbeginn

## Innovative Milchtechnologie (1505-421)

Person(en) verantwortlich	Prof. Dr.-Ing. habil. Jörg Hinrichs
Lehrform	Vorlesung
SWS	2
Inhalt	<ul style="list-style-type: none"> <li>- Analyse der Abfolge von Unit-Operations im Hinblick auf die Prozess-Struktur-Funktions Beziehungen für Milchprodukte</li> <li>- Neue bzw. alternative Prozesse in Forschung und Entwicklung</li> <li>- Innovative Unit operations zum Einsatz für Milch- und Milchprodukte, wie z.B. Membrantrenntechniken; Fraktionieren von Milch Inhaltsstoffen; alternativen zur thermischen Behandlung</li> <li>- Ausgewählte ständig aktualisierte Kapitel aus dem wissenschaftlichen Bereich und wirtschaftlichen Umfeld der Milchtechnologie</li> </ul>
Literatur	Wissenschaftliche Literatur, Dissertationen, Unterlagen des Lehrstuhls
Anmerkungen	<p>Voraussetzung Besuch der Vorlesung "Milchwissenschaft und Technologie"</p> <p>Teilnehmerzahl begrenzt auf maximal 12 Studierende</p>

### **Projektplanung und experimentelles Arbeiten (1505-422)**

Person(en) verantwortlich	Prof. Dr.-Ing. habil. Jörg Hinrichs
Lehrform	Seminar
SWS	1
Inhalt	<ul style="list-style-type: none"> <li>- Sammeln, Evaluieren und strukturiertes Auswerten wissenschaftlicher Literatur.</li> <li>- Nutzung von Datenbanken mit Schwerpunkt Milchwissenschaft und -technologie</li> <li>- Einführen in das wissenschaftliche Schreiben</li> <li>- Teambildung und Organisation der Arbeitsschwerpunkte</li> <li>- Planung von Experimenten und statistische Auswertung</li> <li>- Erstellen eines Entwurfs für ein Projekt mit Arbeitsplan</li> </ul>
Literatur	Fachliteratur / Bibliothek - ergänzende Unterlagen
Anmerkungen	<p>Voraussetzung Besuch der Vorlesung "Milchwissenschaft und Technologie"</p> <p>Teilnehmerzahl begrenzt auf maximal 16 Studierende</p>

### **Technologie und Analyse von Milchprodukten, Praktische Übung (1505-423)**

Person(en) verantwortlich	Prof. Dr.-Ing. habil. Jörg Hinrichs
Lehrform	Übung mit Praktikum
SWS	2



Inhalt	Theoretische Übungen und experimentelle Arbeiten im Rahmen von Projekten unter Nutzung von Pilotanlagen und spezifischen Analysen
Literatur	Wissenschaftliche Literatur; Methodensammlung, Unterlagen des Lehrstuhls
Anmerkungen	Voraussetzung Besuch der Vorlesung "Milchwissenschaft und Technologie" Teilnehmerzahl begrenzt auf maximal 16 Studierende

## Modul: Instrumentelle Analytik und Bioassays (1701-410)

Modulverantwortung	Michael Granvogl
Bezug zu anderen Modulen	-
Teilnahmevoraussetzungen	-
Sprache	deutsch/englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	1 Semester
Verbindlichkeit	Wahl
Studienleistung	Auswertung von Versuchsergebnissen in Form eines Berichts
Prüfungsleistung	Mündliche Prüfung
Modulprüfung	Mündliche Prüfung
Prüfungsdauer	30 Minuten
Arbeitsaufwand	56 h Präsenz + 169 h Eigenanteil = 225 workload
Fachkompetenzen / Lern- und Qualifikationsziele	Die Studierenden beherrschen grundlegende Kenntnisse und Fertigkeiten - im Einsatz von Enzymen und Antikörpern in der instrumentellen Analytik - im Einsatz flüssigchromatographischer Analysetechniken (HPLC, HPTLC) - in der Kopplung flüssigchromatographischer Analysetechniken mit Methoden der Biodetektion sowie mit der Massenspektrometrie
Schlüsselkompetenzen	siehe Fachkompetenzen
Anmerkungen	Teilnehmerbegrenzung: 10 Plätze Der Eingang der Anmeldung ist entscheidend für die Platzvergabe. Anmeldung über ILIAS: <a href="https://ilias.uni-hohenheim.de/ilias.php?ref_id=758210&amp;cmdClass=ilrepositorygui&amp;cmdNode=tr&amp;baseClass=ilrepositorygui">https://ilias.uni-hohenheim.de/ilias.php?ref_id=758210&amp;cmdClass=ilrepositorygui&amp;cmdNode=tr&amp;baseClass=ilrepositorygui</a> .

<b>Instrumentelle Analytik und Bioassays, Vorlesung (1701-411)</b>	
Person(en) verantwortlich	Dr. rer. nat. Claudia Oellig, Michael Granvogl
Lehrform	Vorlesung
SWS	2
Inhalt	Grundlagen und Methoden der instrumentellen Flüssigkeitschromatographie (HPLC, HPTLC) Enzymassays Immunoassays Rezeptorassays Zellassays Kopplung der Flüssigkeitschromatographie mit Bioassays (wirkungsbezogene Analytik) Kopplung der Flüssigkeitschromatographie mit der Massenspektrometrie
Literatur	Skript mit speziellen Literaturempfehlungen zu den einzelnen Themengebieten
<b>Instrumentelle Analytik und Bioassays, Übung (1701-412)</b>	
Person(en) verantwortlich	Dr. rer. nat. Claudia Oellig, Michael Granvogl
Lehrform	Übung
SWS	3
Inhalt	Flüssigkeitschromatographie (HPLC, HPTLC, IC) Kopplung der Flüssigkeitschromatographie mit Massenspektrometrie Kopplung Flüssigkeitschromatographie mit Bioassays (wirkungsbezogene Analytik) Immunoassays
Literatur	Skript mit speziellen Literaturempfehlungen zu den einzelnen Themengebieten

## **Modul: Integrated Bioprocess Engineering - Bioproduction (1510-420)**

Modulverantwortung	Prof. Dr.-Ing. Rudolf Hausmann
Bezug zu anderen Modulen	Is part of the module series Integrated Bioprocess Engineering
Teilnahmevoraussetzungen	First practical experiences in microbiology are required
Sprache	deutsch/englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester

Dauer des Moduls	geblockt
Verbindlichkeit	Wahl
Studienleistung	Regular and active participation in the laboratory course (laboratory notebook and scientific report), the lecture, the exercises and the holding of a seminar talk.
Modulprüfung	Laboratory performance, lab book and colloquium (20%), seminar presentation (20%), oral exam (60%)
Prüfungsdauer	20 Minuten
Arbeitsaufwand	90 h attendance + 135 h independent study = 225 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	After the completion of the module participants, 1. are able to design of media and lay-out feed compositions and strategies 2. are able to explain all functions of bioreactors and safely operate bioreactors. 3. Explain kinetics of bioprocesses and modelling thereof 4. Are able to express expectations on the scale-up of bioprocesses.
Schlüsselkompetenzen	After the completion of the module the participants - have demonstrated working in a self-organized team - have analyzed and interpreted experimental data and discussed them theoretically - have experienced and adapted to an interdisciplinary field. - have enhanced their scientific written and verbal skills.
Anmerkungen	places: 9rnRegistration for module: by email to: bvt@uni-hohenheim.de Registration period: until the last working day before the module start. Criteria for admission is granted: Mostly after first-served basis.
<b>Bioproduction, lecture (1510-421)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. Rudolf Hausmann
Person(en) begleitend	Dr. rer. nat. Karin Moß, Dr.-Ing. Marius Henkel
Lehrform	Vorlesung mit Seminar und Übung
SWS	2
Inhalt	Design of media and laying-out of feed strategies and compositions Functions of bioreactors Kinetics of bioprocesses and modelling thereof Scale-up of bioprocesses
Literatur	- J. Villadsen, J Nielsen and G Lidén (2011): Bioreaction Engineering Principles, Springer - P. M. Doran (2013): Bioprocess Engineering Principles, Academic Press - S Liu (2013): Bioprocess Engineering: Kinetics, Biosystems, Sustainability, and Reactor Design, Elsevier

	<p>- S. K. Niazi and J. L. Brown (2016): Fundamentals of Modern Bioprocessing, CRC Press</p> <p>- N. S. Mosier and M. R. Ladisch (2009): Modern Biotechnology: Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals, Wiley/AICHE</p>
<b>Bioproduction, internship (1510-422)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. Rudolf Hausmann
Person(en) begleitend	Dr. rer. nat. Karin Moß, Dr.-Ing. Marius Henkel
Lehrform	Praktikum
SWS	4
Inhalt	<p>Exemplary production of an heterologous protein in E.coli high cell density bioreactor cultivation</p> <p>Keeping of a labjournal / protocol</p> <p>Documentation and evaluation of bioreactor cultivation</p> <p>Working under sterile conditions</p> <p>On and off line analysis of key cultivation parameters (pO<sub>2</sub>, pH, xO<sub>2</sub>, xCO<sub>2</sub>, cell density, substrate and product concentration)</p> <p>Bioreactor set-up: functions and peripherals</p> <p>Independently plan and carry out operations on the bioreactor</p> <p>Application of feed and induction strategies</p>
Literatur	Henkel et al. (2015): Teaching bioprocess engineering to undergraduates: Multidisciplinary hands-on training in a one-week practical course, in: Biochemistry and Molecular Biology Education, Vol. 43, Iss. 3, pp 189–202 ( <a href="http://dx.doi.org/10.1002/bmb.20860">http://dx.doi.org/10.1002/bmb.20860</a> )
Anmerkungen	Attendance and active participation in the laboratory course is mandatory. Due to the fact that every group has full responsibility for performing their own experiment, in-lab times will be flexible but require reasonable planning on the main experimental days.

## **Modul: Integrated Bioprocess Engineering - Upstream Processing (1510-440)**

Modulverantwortung	Prof. Dr.-Ing. Rudolf Hausmann
Bezug zu anderen Modulen	Completion of the module "Recombinant Proteins (1506-430)" is recommended.
Teilnahmevoraussetzungen	Basic knowledge in microbiology, biochemistry and genetics
Sprache	englisch
ECTS	7,5

Angebotshäufigkeit	jedes WS
Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Wahl
Studienleistung	Regular and active participation in the internship (laboratory notebook and scientific report), the lecture, the exercises and the holding of a seminar talk.
Modulprüfung	Laboratory performance, lab book and colloquium (20%), seminar presentation (20%), oral exam (60%)
Prüfungsdauer	20 Minuten
Arbeitsaufwand	90 h attendance + 135 h independent study = 225 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	After the completion of the module participants, ... 1. ...are able to theoretically report on products of industrial biotechnology. 2. ...are able to evaluate advantages and disadvantages of different biological systems. 3. ...are able to give an overview in current methods of upstream processing using bio-molecular methods. 4. ...have practically developed skills of the strain construction with a simple example. 5. ... have submitted a scientific documentation and report. 6. ... are able to analyze biosynthetic pathways in respect to the involved enzymes and corresponding genes with the help of internet-based databases.
Schlüsselkompetenzen	After the completion of the module participants, ... 1. ... have demonstrated organizational skills in the planning of the practical experiments. 2. ... have shown independent working in the lab. 3. ... have trained analytical thinking in the preparing of the scientific reports. 4. ...have practiced written and oral expression in scientific English. 5. ... have practiced communication and cooperation skills in planning the lab experiments.
Anmerkungen	Available places: 9 Registration for module: by email to: bvt@uni-hohenheim.de Registration period: until the last working day before the module start. Criteria for admission is granted: Mostly after first-served basis.
<b>Industrial Biotechnology (1510-441)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. Rudolf Hausmann
Person(en) begleitend	Dr. rer. nat. Karin Moß, Dr.-Ing. Marius Henkel
Lehrform	Vorlesung mit Übung und Seminar
SWS	2
Inhalt	- Overview of the products of industrial biotechnology with a focus on food additives and ingredients (for example, citric acid, glutamate, vitamin B2, etc ...) - In-depth theoretical knowledge of the use of biological, in particular microbial systems for the production of economically valuable biochemical.

	<ul style="list-style-type: none"> <li>- Biosynthetic understanding of the primary and the secondary metabolism and fermentation products.</li> <li>- Represent theoretically optimal biosynthetic pathways and to calculate and establish the corresponding maximum yield coefficients.</li> </ul>
Literatur	<ul style="list-style-type: none"> <li>- P. M. Doran (2013): Bioprocess Engineering Principles, Academic Press</li> <li>- Shijie Liu (2013): Bioprocess Engineering: Kinetics, Biosystems, Sustainability, and Re-actor Design, Elsevier</li> <li>- S. K. Niazi and J. L. Brown (2016): Fundamentals of Modern Bioprocessing, CRC Press</li> <li>- N. S. Mosier and M. R. Ladisch (2009): Modern Biotechnology: Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals, Wiley/AICHE</li> </ul>
Anmerkungen	Compulsive attendance of the lectures and exercises.
<b>Genetic Strain Construction (1510-442)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. Rudolf Hausmann
Person(en) begleitend	Dr. rer. nat. Karin Moß, Dr.-Ing. Marius Henkel
Lehrform	Praktikum
SWS	4
Inhalt	<p>A prokaryotic expression system (E. coli) with a plasmid cloning vector has been successfully constructed for the heterologous protein production.</p> <p>Options for different strategies have been investigated and discussed. These include:</p> <ul style="list-style-type: none"> <li>- expression systems, promotor and induction systems, restriction endonucleases and respective recognition sites, genetic markers, preparation of vector, DNA-preparation, ligation, transformation, screening, molecular tags.</li> </ul> <p>A laboratory work and evaluation of results have been documented in a lab journal and scientific report.</p>
Literatur	<ul style="list-style-type: none"> <li>- M. Green and J. Sambrook (2012): Molecular Cloning: A Laboratory Manual (Fourth Edition), CSH Press</li> <li>- Cornel Mülhardt (2013) Der Experimentator Molekularbiologie / Genomics, Springer</li> </ul>
Anmerkungen	Attendance and active participation in the laboratory course is mandatory. Due to the fact that every group has full responsibility for performing their own experiment, in-lab times will be flexible but require reasonable planning on the main experimental days.

## **Modul: Integrated Bioprocess Engineering – Bioseparation Process Science (Downstream Processing) (1510-430)**

Modulverantwortung	Prof. Dr.-Ing. Rudolf Hausmann
Teilnahmevoraussetzungen	-

Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (Block 3)
Verbindlichkeit	Wahl
Studienleistung	Regular and active participation in the laboratory course (laboratory notebook and scientific report), the lecture, the exercises and the holding of a seminar talk.
Modulprüfung	Laboratory performance, lab book and colloquium (20%), seminar presentation (20%), oral exam (60%)
Prüfungsdauer	20 Minuten
Arbeitsaufwand	90 h attendance + 135 h independent study = 225 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	The participants should obtain a theoretic overview of all relevant process steps used in the purification of industrial bioproducts. At the end of the module they should be able to outline a product-specific scheme of purification. In a hands-on training the participants will have performed and analyzed some selected methods.
Schlüsselkompetenzen	After the completion of the module the participants - have demonstrated working in a self-organized team - have analyzed and interpreted experimental data and discussed them theoretically - have experienced and adapted to an interdisciplinary field. - have enhanced their scientific written and verbal skills.
Anmerkungen	Available places: 9 Registration for module: by email to: bvt@uni-hohenheim.de Registration period: until the last working day before the module start. Criteria for admission is granted: Mostly after first-served basis.
<b>Downstream Processing (1510-431)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. Rudolf Hausmann
Person(en) begleitend	Dr. rer. nat. Karin Moß, Dr.-Ing. Marius Henkel
Lehrform	Vorlesung mit Seminar und Praktikum
SWS	6
Inhalt	The module comprises a lecture, a seminar and a lab hands-on training in which the purification of bioproducts from the original state as a component of a fermentation broth through progressive purification steps to a final product are the topic. Outline: 1) Introduction 2) Solid-Liquid Separation

	<p>3) Cell Disruption</p> <p>4) Precipitation and Crystallization</p> <p>5) Preparative Chromatography</p> <p>6) Membrane Separation</p> <p>7) Extraction</p> <p>8) Refolding</p> <p>9) Summary</p>
Literatur	R. G. Harrison, P. Todd, S. R. Rudge, D. P. Petrides (2003): Bioseparations Science and Engineering, Oxford University Press
Anmerkungen	Attendance and active participation in the laboratory course is mandatory. Due to the fact that every group has full responsibility for performing their own experiment, in-lab times will be flexible but require reasonable planning on the main experimental days.

## **Modul: Internship FSE (Industrial placement) (12 weeks, 15 ECTS) (1500-510)**

Modulverantwortung	Prof. Dr.-Ing. habil. Jörg Hinrichs
Teilnahmevoraussetzungen	Admission to the Master's programme has to be present when beginning the internship. The internship can be completed at a national or international research center or at a research and development department of a company in Germany or abroad that is related to the Life Sciences: food, pharma-ceutical as well as their supplying industries, plant design and engineer-ing and process technology.
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes Semester
Semesterlage	2. Semester
Dauer des Moduls	n. V.
Verbindlichkeit	Wahl
Modulprüfung	Internship report
Arbeitsaufwand	450 h
Fachkompetenzen / Lern- und Qualifikationsziele	Upon completion of this module students - have gained insight into research and development in the area of food science and engineering - expand their methodological repertoire
Schlüsselkompetenzen	Upon completion of this module students - have gained insight into organizing research projects - have sharpened their critical thinking skills when developing practical solutions - have learned how to work by trial and error
Anmerkungen	Students choose a supervisor related to the subject-area prior to begin-ning their internship (Prof. Hinrichs, Prof. Carle, Prof. Kohlus,



	Prof. Weiß, Prof. Hitzmann, Prof. Schmidt). The supervisor decides whether the internship placement is appropriate and assesses the report. This module does not count towards the final grade. Please note: whereas only 15 ECTS can be awarded, the duration of the in-ternship is not limited to 12 weeks.
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## **Modul: Internship FSE (Industrial placement) (6 weeks, 7,5 ECTS) (1500-500)**

Modulverantwortung	Prof. Dr.-Ing. habil. Jörg Hinrichs
Teilnahmevoraussetzungen	Admission to the Master's programme has to be present when beginning the internship. The internship can be completed at a national or international research center or at a research and development department of a company in Germany or abroad that is related to the Life Sciences: food, pharmaceutical as well as their supplying industries, plant design and engineering and process technology.
Sprache	deutsch/englisch
ECTS	7,5
Angebotshäufigkeit	jedes Semester
Semesterlage	2. Semester
Dauer des Moduls	n. V.
Verbindlichkeit	Wahl
Modulprüfung	Internship report
Arbeitsaufwand	225 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	Upon completion of this module students - have gained insight into research and development in the area of food science and engineering - expand their methodological repertoire
Schlüsselkompetenzen	Upon completion of this module students - have gained insight into organizing research projects - have sharpened their critical thinking skills when developing practical solutions - have learned how to work by trial and error - improve their team and communication skills
Anmerkungen	Students choose a supervisor related to the subject-area prior to beginning their internship (Prof. Hinrichs, Prof. Carle, Prof. Kohlus, Prof. Weiß, Prof. Hitzmann, Prof. Schmidt). The supervisor decides whether the internship placement is appropriate and assesses the report. This module does not count towards the final grade. Please note: whereas only 7,5 ECTS can be awarded, the duration of the in-ternship is not limited to 6 weeks.

## **Modul: Master's Thesis Food Science and Engineering (1500-410)**

Teilnahmevoraussetzungen	Successful completion of modules in the amount of 78 credits.
Sprache	englisch
ECTS	30
Angebotshäufigkeit	jedes Semester
Semesterlage	4. Semester
Dauer des Moduls	1 Semester
Verbindlichkeit	Pflicht
Modulprüfung	Bound Master's thesis and, if applicable, oral presentation of the findings
Arbeitsaufwand	900 h
Fachkompetenzen / Lern- und Qualifikationsziele	<p>Upon successful completion of the module students</p> <ul style="list-style-type: none"> <li>- are able to conduct independent experimental research in the field of food science and engineering or an adjacent field according to given instructions on an assigned topic, record their findings and discuss them</li> <li>- have extensive knowledge and expertise in the topic of their Master's thesis</li> <li>- are able to employ scientific methods in the field of food science and engineering or adjoining disciplines and present their findings as a scientific work</li> <li>- are able to independently work with complicated laboratory equipment</li> </ul>
Anmerkungen	Registration for the module on an individual basis in consultation with the supervising professor. The Master's thesis is graded by two professors, one of which has to be in charge of at least one compulsory module of the programme in Food Science and Engineering

## **Modul: Mathematics and Computational Sciences of the Earth System (1102-400)**

Modulverantwortung	apl. Prof. Dr. Georg Zimmermann
Bezug zu anderen Modulen	Mathematische Grundlagen für das Modul 1102-410.
Teilnahmevoraussetzungen	Solide Grundkenntnisse in Mathematik wie sie in einem typischen B.Sc.-Programm behandelt werden.
Sprache	englisch
ECTS	4
Angebotshäufigkeit	jedes WS
Semesterlage	2. Semester
Dauer des Moduls	1 Semester
Verbindlichkeit	Wahl

Studienleistung	50 % der Punkte von den Hausübungen
Prüfungsleistung	Klausur
Modulprüfung	Klausur
Prüfungsdauer	90 Minuten
Arbeitsaufwand	56 h Präsenzzeit, 64 h Eigenanteil, 120 h Arbeitsaufwand.
Fachkompetenzen / Lern- und Qualifikationsziele	Ziel diese Moduls ist es, dass die studentes die mathematischen Werkzeuge aus Analysis und Linearer Algebra beherrschen, die für gewöhnliche und partielle Differentialgleichungen benötigt werden. Darüberhinaus lernen sie, einfache Computerprogramme zu schreiben, um sowohl verwandte mathematische Probleme lösen als auch Daten analysieren zu können.
Schlüsselkompetenzen	Ziel diese Moduls ist es, dass die studentes genügend Routine in den oben genannten Bereichen erlangen, um sich bei der Lösung von Differentialgleichungen auf deren Methodik konzentrieren zu können. Darüberhinaus erlangen sie Grundfertigkeiten im Programmieren und in der Datenanalyse.
Anmerkungen	Teilnehmerzahl: Unbeschränkt.
<b>Applied Mathematics for Earth and Climate System Science (1102-401)</b>	
Person(en) verantwortlich	apl. Prof. Dr. Georg Zimmermann
Lehrform	Vorlesung
SWS	2
Inhalt	Linear algebra: matrices and linear mappings, eigenvalues and eigenvectors, quadratic forms and definiteness. Differentiation: ordinary and partial derivatives, gradient, divergence and curl, Laplacian operator. Integration: indefinite and definite integrals, curves and line integrals, conservative vector fields, surfaces and surface integrals, integral theorems by Gauß and Stokes.
Literatur	Any standard book on mathematics for physicists or engineers. in English: basic (undergraduate level): M.L. Boas, Mathematical Methods in the Physical Sciences advanced (graduate level): G. B. Arfken, Mathematical Methods for Physicists in German: H. Fischer / H. Kaul, Mathematik für Physiker 1 & 2
<b>Computer Exercises for Earth and Climate System Science (1102-402)</b>	
Person(en) begleitend	Dr. rer. nat. Andreas Behrendt
Lehrform	Übung
SWS	2

Inhalt	Exercises to the topics of Applied Mathematics for Earth and Climate System Science using the programming environment Mathematica. Analysis and visualization of earth system observations and climate data using Mathematica.
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## **Modul: Mathematics and Computational Sciences of the Earth System II (1102-410)**

Modulverantwortung	apl. Prof. Dr. Georg Zimmermann
Bezug zu anderen Modulen	Fortsetzung des Moduls 1102-400.
Teilnahmevoraussetzungen	Erfolgreicher Abschluss des Moduls 1102-400.
Sprache	englisch
ECTS	6
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	1 Semester
Verbindlichkeit	Wahl
Studienleistung	50 % der Punkte von den Hausübungen
Prüfungsleistung	Klausur
Modulprüfung	Klausur
Prüfungsdauer	90 Minuten
Arbeitsaufwand	56 h Präsenzzeit, 124 h Eigenanteil, 180 h Arbeitsaufwand.
Fachkompetenzen / Lern- und Qualifikationsziele	Ziel diese Modul ist es, dass die studentes gewöhnliche und partielle Differentialgleichungen als solche und auch einige spezielle Typen erkennen können. Sie wissen, wie bestimmte Typen von Differentialgleichungen gelöst werden können, einige explizit, andere numerisch. Sie können autonome Systeme erkennen, stationäre Lösungen finden und deren Stabilitätseigenschaften bestimmen.
Schlüsselkompetenzen	Ziel dieses Modul ist es, dass die studentes Differentialgleichungen verstehen können in dem Sinne, dass sie erkennen, welche Effekte durch die einzelnen Terme modelliert werden. Sie kennen Stabilitätseigenschaften und wie sie zu bestimmen sind.
Anmerkungen	Teilnehmerzahl: Unbeschränkt. Anmeldung: Beim Dozenten zu Beginn des Semesters.
<b>Mathematics and Computational Sciences of the Earth System II (1102-411)</b>	
Person(en) verantwortlich	apl. Prof. Dr. Georg Zimmermann
Lehrform	Vorlesung mit Übung
SWS	4

Inhalt	Ordinary differential equations: numerical methods, autonomous systems and the stability of their stationary solutions. Partial Differential equations: wave equation, heat equation, numerical methods
Literatur	Lecture notes provided by the lecturer. Additional, if so desired: Any standard book on mathematics for physicists or engineers. in English: basic (undergraduate level): M.L. Boas, Mathematical Methods in the Physical Sciences advanced (graduate level): G. B. Arfken, Mathematical Methods for Physicists in German: H. Fischer / H. Kaul, Mathematik für Physiker 1 & 2

## Modul: Metal Coordination Chemistry in Biomolecules (1301-450)

Modulverantwortung	Prof. Dr. rer. nat. Henry Strasdeit
Teilnahmevoraussetzungen	English and German language skills.
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 3)
Verbindlichkeit	Wahl
Studienleistung	Regular attendance and active participation.
Modulprüfung	Written exam
Prüfungsdauer	90 Minuten
Arbeitsaufwand	56 h attendance + 132 h independent study = 188 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	The students - know the paramount importance of metal ions in biochemistry and examples of the various functions of metal ions in biochemical processes. - know the basics of complex formation involving metal cations. - understand the principles of studying metal complexes. - know how metal ions and biological ligands mutually affect their properties. - learn how cellular concentrations of essential and toxic metal ions are regulated.

	<ul style="list-style-type: none"> <li>- know the role of essential metal ions in the generation and utilization of the electrochemical potential of the cell.</li> <li>- realize that the chemical and physical principles used to describe inanimate systems can be equally applied to organisms.</li> </ul>
Anmerkungen	Maximum number of participants: 14
<b>Bioinorganic Chemistry (1301-451)</b>	
Person(en) verantwortlich	Prof. Dr. rer. nat. Henry Strasdeit
Lehrform	Vorlesung
SWS	2
Inhalt	Molecular foundations of the biological functions of metals; overview of biologically important metal ions and ligands; some principles of metal coordination chemistry; the basis of metal ion homeostasis; toxic metal ions; biological electron transfer: cytochromes, iron-sulfur proteins, blue copper proteins; „synthetic analogues“ concept; biological Lewis acid catalysis: carboxypeptidase, carboanhydrase, aconitase; transport of molecular oxygen: hemoglobin, hemerythrin, hemocyanine; structural functions of metal ions: calmodulin, zinc finger proteins; transport and storage of metal ions; physical methods for the characterization of metal ion-containing biomolecules (e. g. protein crystallography).
Literatur	Kaim, W., Schwederski, B., and Klein, A.: Bioinorganic Chemistry - Inorganic Elements in the Chemistry of Life. Wiley, Chichester, 2013
Anmerkungen	The lecture is suited as additional course for students of scientific Bachelor's programmes (from the 4th semester on) and other scientific Master's programmes.
<b>Ion Transporters (1301-452)</b>	
Person(en) verantwortlich	Prof. Dr. Julia Fritz-Steuber
Lehrform	Vorlesung
SWS	1
Inhalt	<p>The molecular basis for the biological function of ion transporters will be discussed. A focus is on systems for active and passive transport of Na<sup>+</sup>, K<sup>+</sup> and Ca<sup>2+</sup>.</p> <p>Topics:</p> <ul style="list-style-type: none"> <li>- The electrochemical membrane potential</li> <li>- Physiological relevance of Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup></li> <li>- Primary producers of the electrochemical potential (cation pumps)</li> <li>- How channels work/how to study channels</li> <li>- Voltage- versus ligand-gated channels</li> <li>- Structure-function analysis of ion transporters</li> <li>- Comparing transport rates and ion selectivities of different systems</li> </ul>
Literatur	Ashcroft, F. M.: Ion Channels and Disease. Academic Press
Anmerkungen	The lecture is suited as additional course for students of other scientific Master's programmes.

<b>Principles of Coordination Chemistry (1301-453)</b>	
Person(en) verantwortlich	Priv. Doz. Dr. Wolfgang Einholz
Lehrform	Vorlesung
SWS	1
Inhalt	<p>The lecture covers the main principles of the formation of metal complexes as well as physical methods for the investigation especially of biological important metal complexes.</p> <p>In detail the following subjects will be treated:</p> <ul style="list-style-type: none"> <li>- electronic structures of metal cations</li> <li>- electronic, magnetic, and optical properties of metal complexes</li> <li>- theories of the formation of metal complexes</li> <li>- physical principles of the investigation of metal complexes</li> <li>- introduction to new spectroscopic methods for the investigation of biological relevant metal complexes.</li> </ul>
Literatur	<p>Riedel, E.: Anorganische Chemie, de Gruyter, Berlin, 2007</p> <p>Shriver, D.F., Atkins, P.W., Langford, C.H.: Anorganische Chemie, Wiley-VCH Weinheim, 1997</p> <p>Huheey, J., Keiter, E., Keiter, R.: Anorganische Chemie - Prinzipien von Struktur und Reaktivität, de Gruyter, Berlin, 2003</p> <p>Cotton, F.A., Wilkinson, G.: Anorganische Chemie, Verlag Chemie Weinheim, 1982</p> <p>Atkins, P.W.: Quanten, VCH, Weinheim, 1993</p>

## **Modul: Microbial Ecology and Diversity in the Food Environment (1501-420)**

Modulverantwortung	Prof. Dr. Herbert Schmidt
Bezug zu anderen Modulen	Required for the major in Food Microbiology along with the module "Identification and characterization of foodborne microorganisms (1501-410)".
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (Block 4)
Verbindlichkeit	Wahl
Studienleistung	Regular attendance in the seminar and oral presentation
Modulprüfung	exam
Prüfungsdauer	120 Minuten
Arbeitsaufwand	90 h attendance + 90 h independent study = 180 workload

Fachkompetenzen / Lern- und Qualifikationsziele	Students gain theoretical knowledge in relevant areas of Food Microbiology and learn to present, discuss and apply them in a practical context.
Schlüsselkompetenzen	Students are able to learn and work self-motivated, they have improved written and oral skills as well as their scientific communication capabilities.
Anmerkungen	Available places: 14. Registration required. All students taking the Major in Food Microbiology of the program in Food Biotechnology are allowed to participate. A limited number of other students of the Master's program in Food Biotechnology, the program in Food Science and Engineering as well as Bioeconomy may take this module after being selected for participation.

## **Modul: Molekulare Sinnesphysiologie (2301-430)**

Modulverantwortung	Prof. Dr. Michael Föller
Teilnahmevoraussetzungen	Bachelorabschluss mit biologischem Profil
Sprache	deutsch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Wahl
Studienleistung	Regelmäßige Teilnahme, Vortrag im Grundlagenseminar und Vorstellung einer wissenschaftlichen Publikation
Modulprüfung	Klausur
Arbeitsaufwand	56 h Präsenz + 154 h Eigenanteil = 210 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	Ziel des Moduls ist, dass die Studierenden nach dem Abschluss des Moduls in der Lage sind, durch vertieftes Wissen in Bereichen der Sinnesphysiologie eine Präsentation zu aktuellen Forschungsergebnissen vorzustellen und diese im Kreise der Mitstudierenden zu diskutieren. Nach Abschluss des Moduls sind die Studierenden in der Lage, die erhaltenen Methodenkenntnisse zu nutzen und die dabei erworbene Praxis bei der experimentellen Forschungsarbeit im Labor umzusetzen.
Anmerkungen	Anzahl Teilnehmerplätze: 8 Anmeldung zur Teilnahme am Modul über ILIAS/Auswahlverfahren
<b>Molekulare Sinnesphysiologie (2301-431)</b>	
Person(en) verantwortlich	apl. Prof. Dr. rer. nat. Jörg Strotmann, Prof. Dr. Michael Föller
Lehrform	Seminar mit Übung
SWS	4



Inhalt	<ul style="list-style-type: none"> <li>- Sinnesorgane, Sinneszellen: strukturelle und molekulare Spezialisierungen</li> <li>- Perirezeptor.Prozesse</li> <li>- Transduktionsmechanismen, Cross-talk, Regelkreise</li> <li>- Desensibilisierung, Adaption, Inaktivierung sensorischer Reize</li> <li>- Neuronale "Verdrahtung" sensorischer Systeme</li> <li>- Integration multimodaler Information</li> <li>- Grundlagen für die Erfassung verschiedener Sinnesmodalitäten</li>   <li>- Vorträge der Studierenden und Diskussionsrunden zu gezielten Fragestellungen</li> <li>- Experimentelle Übungen zur molekularen Sinnesphysiologie</li> </ul>
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## **Modul: Prinzipien der technischen Milchverarbeitung und analytische Methoden (1505-400)**

Modulverantwortung	Prof. Dr.-Ing. habil. Jörg Hinrichs
Teilnahmevoraussetzungen	-
Sprache	deutsch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 3)
Verbindlichkeit	Wahl
Studienleistung	Regelmäßige und aktive Teilnahme, Seminararbeit (20% der Abschlussnote), Protokolle zum Praktikum und Exkursion
Modulprüfung	Klausur (90 Minuten) oder mündliche Prüfung (20 Minuten)
Arbeitsaufwand	78 h Präsenzzeit + 98 h Eigenanteil = 176 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	Ziel des Moduls ist, dass die Studierenden nach dessen Abschluss in der Lage sind, technische Prozesse der Verarbeitung von Milch zu verschiedenen Produkten vertieft zu durchdringen. Im Speziellen soll die Auswirkung von Unit-Operations des Prozesses auf die Inhaltsstoffe diskutiert und analysiert werden. Zielgerichtet auf die Problemstellung sollen sie in der Lage sein, geeignete Methoden zur Kontrolle und solche zur Bewertung funktioneller Eigenschaften auszuwählen und anzuwenden.
Schlüsselkompetenzen	Ziel des Moduls ist, dass die Studierenden nach dessen Abschluss in der Lage sind, selbstständig technische Prozesse der Milchbe- und -verarbeitung unter Berücksichtigung der Anforderungen, z. B. Erhalt von wertgebenden Inhaltsstoffen, Sicherheit, Haltbarkeit außerhalb der Kühlkette kritisch zu analysieren. Darüber hinaus sollen die Studierenden die Fähigkeit besitzen, die Aufgaben und Auswirkungen einzelner Uni-Operation auf Milchinhaltstoffe zu erkennen, um Variation in der Abfolge der Uni-Operation beurteilen

	zu können und ggf. eine Alternative theoretisch zu prüfen und zu bewerten.
Anmerkungen	Anzahl Teilnehmerplätze: 10 Anmeldung zum Modul: Im Fachgebiet Anmeldezeitraum: Februar-März Studierende, die eine ansteckende Krankheit nach Bundesseuchengesetz haben, dürfen am Praktikum nicht teilnehmen.
<b>Prinzipien der Milchverarbeitung und analytische Methoden (1505-401)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. habil. Jörg Hinrichs
Lehrform	Vorlesung
SWS	2
Inhalt	<p>Prozess-Struktur-Funktions-Beziehungen im System Milch und Milchprodukte</p> <ul style="list-style-type: none"> <li>- unitoperations, wie z. B. Homogenisieren; Emulgieren, Aufschäumen, thermische Be-handlung.</li> <li>- Komponenten von Prozessanlage</li> <li>- Analysen zur Beurteilung von Qualitätsparametern, wie wertgebende Inhaltsstoffe, techno- und biofunktionellen Eigenschaften, Textur und Rheologie</li> <li>- Interaktion von Technologie und Milch(product)matrix in Bezug auf Komposition, funktionelle Eigenschaften und Sensorik</li> <li>- Mikrobiologische Aspekte &amp; Analysen mit Auslegung der Prozessbedingungen</li> <li>- Produktbeispiele: Konsummilch-Produkte und Drinks sowie Eiskrem</li> </ul>
Literatur	<p>Töpel, A.: Chemie und Physik der Milch, Behr´s Verlag.  Kessler H. G.: Food and Bio Process Engineering - Dairy Technology, Verlag A. Kessler, München.  Belitz H.-D. Grosch W., Schieberle P. Food Chemistry Springer Verlag  Ausgegebene Skripte.</p>
<b>Prozessanalyse der technischen Milchverarbeitung (1505-402)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. habil. Jörg Hinrichs
Lehrform	Seminar
SWS	1
Inhalt	<p>Die Studierenden sollen: 1. einen in der Vorlesung dargestellten technischen Prozess für Herstellung eines Milchprodukts hinsichtlich Ziel der Uni-Operation in Bezug chemischer, biochemischer, physikalischer und mikrobiologischer Aspekte analysieren und präsentieren. 2. die Uni-Operation für den technischen Prozess zur Herstellung eines innovativen Milchprodukts für spezielle Ernährungsanforderungen / technofunktionelle Anwendungen erarbeiten, analysieren, Analysenmethoden zur Prüfung und Überwachung geforderter Eigenschaften sowie Reinigungs- und Desinfektionsroutinen vorschlagen.</p>

Literatur	Töpel, A.: Chemie und Physik der Milch, Behr's Verlag. Kessler H. G.: Food and Bio Process Engineering - Dairy Technology, Verlag A. Kessler, München. Belitz H.-D. Grosch W., Schieberle P. Food Chemistry Springer Verlag aktuelle Fachliteratur
<b>Milchtechnologisches Praktikum (1505-403)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. habil. Jörg Hinrichs
Lehrform	Praktikum
SWS	2
Inhalt	Ausgehend vom Rohstoff Milch über verschiedene Uni-Operation durchgeführt mit Technikumsanlagen der Forschungs- und Lehrmolkerei Hohenheim werden Milchprodukte, wie z. B. Joghurt, Käse, Eiskrem hergestellt und verschiedene chemisch-physikalische, rheologische und sensorische Analyse durchgeführt.
Literatur	Töpel, A.: Chemie und Physik der Milch, Behr's Verlag. Kessler H. G.: Food and Bio Process Engineering - Dairy Technology, Verlag A. Kessler, München. Ausgegebene Skripte.

## **Modul: Process Driven Product Design: Cereals and Sweets (1503-510)**

Modulverantwortung	Prof. Dr.-Ing. Reinhard Kohlus
Teilnahmevoraussetzungen	Completion of the modules "Food Process Design I (1503-520)" and "Food Process Design II (1503-500)" is beneficial to understand the topic but not required.
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (Block 2)
Verbindlichkeit	Wahl
Modulprüfung	Oral examination
Arbeitsaufwand	56 h attendance + 132 independent study = 188 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	The students will learn to design a process based on product on product requirements in the field of sugar based, products.  They know key product process interactions for the discussed product groups and how to uses these.

	The learned skills focus on applicable knowledge which is based on strong basic / theoretical foundations allowing to apply it in a wide context.
Schlüsselkompetenzen	Key competencies addressed in this module are critical problem assessment and analytical thinking. Systematic problem solving.
Anmerkungen	Maximum number of participants: 24 Registration via ILIAS is open until October 11th
<b>Process Driven Product Design: Cereals and Sweets, Lecture (1503-511)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. Reinhard Kohlus
Person(en) begleitend	Hartmut Dr. Rohse, Hiltrud Rohenkohl, Dr. Wolfgang Bindzus
Lehrform	Vorlesung
SWS	4
Inhalt	<p>The interplay between product quality generation and process design is discussed on three examples in detail. These are sugar articles, breakfast cereals and ice cream. In all three raw material composition and targeted product attributes require specific process conditions. The approach for each product group will be worked out. Typical equipment is explained and process parameter are discussed. Product design aspects are including storage, packaging and quality parameter are covered as well.</p> <p>In detail twin screw extruder, sugar cooker and freezer technology will be introduced. This allows to discuss the examples of breakfast cereals ex cooking extrusion, hard and soft caramel, marshmallows and ice cream.</p>
Anmerkungen	<p>Zucker und Zuckerwaren; H. Hoffmann, W. Mauch, W. Untze; Behrs Verlag 1985,</p> <p>Science of Ice cream; C. Clark, The Royal Society of Chemistry 2004</p> <p>Snack Foods Processing, R. Lusas, L. Rooney, CRC Press, Boca Raton, 2001</p>

## **Modul: Project Work (compulsory) (1500-530)**

Modulverantwortung	Prof. Dr. rer. nat. Lutz Fischer
Teilnahmevoraussetzungen	M.Sc. Food Science and Engineering, M.Sc. Food Biotechnology
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes Semester
Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (n. V.)
Verbindlichkeit	Pflicht

Studienleistung	Synopsis, report, presentation
Modulprüfung	Project work
Arbeitsaufwand	210 h
Fachkompetenzen / Lern- und Qualifikationsziele	<p>The student will learn to elaborate a scientific assignment. The module is designed to introduce to the later work in frame of the master thesis. It is structured in three parts:</p> <ul style="list-style-type: none"> <li>- preparation of a literature based exposé about the chosen topic</li> <li>- experimental work in the laboratory repeating selected experiments of the literature (ca. 10-14 working days)</li> <li>- oral presentation of the topic (15-25 minutes)</li> </ul> <p>The topic of the project work is discussed and given by the head of a department (member of the compulsory modules). The supervision will be conducted by a postgraduate of the department.</p> <p>The module is successfully performed, when all three parts were passed. Grades will be informally given to the student in oral form. The module is scored passed/failed without an official grade.</p>
Schlüsselkompetenzen	<p>The student will learn to elaborate a scientific assignment. The module is designed to introduce to the later work in frame of the master thesis. It is structured in three parts: - preparation of a literature based exposé or report about the chosen topic or the experimental results respectively - experimental work in the laboratory repeating selected experiments of the literature (ca. 10 - 14 working days) - oral presentation of the topic (15-25 minutes)</p> <p>The topic of the project work is discussed and given by the head of a department (member of the compulsory modules). The supervision will be conducted by a postgraduate of the department.</p> <p>The module is successfully performed, when all three parts were passed. Grades will be informally given to the student in oral form. The module is scored passed/failed without an official grade.</p>
Anmerkungen	The project work may be integrated into the course of studies flexibly during the first three semesters. However, it has to be completed before beginning to work on the Master's thesis at the latest. This module does not count towards the final grade.

## **Modul: Project Work (elective) (1500-520)**

Modulverantwortung	Prof. Dr. rer. nat. Lutz Fischer
Teilnahmevoraussetzungen	M.Sc. Food Science and Engineering, M.Sc. Food Biotechnology
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes Semester

Semesterlage	2. Semester
Dauer des Moduls	n. V.
Verbindlichkeit	Wahl
Modulprüfung	Submission of a report and oral presentation of the results.
Arbeitsaufwand	210 h (attendance, including preparation of the synopsis, report and presentation)
Fachkompetenzen / Lern- und Qualifikationsziele	<p>This module serves to introduce students to doing a research project independently, which also prepares them for working on their Master's thesis.</p> <p>The topic is chosen with the supervisor on the basis of the contents of a compulsory or elective module of the programme. The supervisor (postgraduate) is assigned by the department and the execution of</p> <p>There are two options for completing this module.</p> <p>Option A: Literature-based project work</p> <ul style="list-style-type: none"> <li>- Writing a synopsis of the research topic using relevant scientific literature on the topic (10-15 pages). This paper is handed in and discussed with the supervisor.</li> <li>- Experimental reproduction of selected relevant data found in the literature (maximum of 3-5 laboratory days; in consultation with the supervisor). Writing a protocol (5-10 pages). The report is handed in and discussed with the supervisor.</li> <li>- Oral presentation of the topic (25-30 minutes on the synopsis and own data).</li> </ul> <p>Option B: Experimental project work</p> <ul style="list-style-type: none"> <li>- Writing a report (15-25 pages) outlining the experimental task, the materials used as well as methods and results of the experiments (approximately 15 laboratory days).</li> <li>- Analysis of the data in writing.</li> </ul>
Anmerkungen	Registration on an individual basis in consultation with the supervisor. Please refer to the professor in charge of the module most closely re-lated to your desired research topic. This module does not count towards the final grade.

## Modul: Scientific Writing and Reporting (1501-520)

Modulverantwortung	Prof. Dr. Herbert Schmidt
Teilnahmevoraussetzungen	-
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes WS

Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (Block 1)
Verbindlichkeit	Wahl
Modulprüfung	Preparing and giving a ca. 30 minute presentation with ensuing discussion on a given natural scientific topic in English (internally graded, grade does not count towards the final grade)
Arbeitsaufwand	112 h attendance + 113 h independent study = 225 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	<p>Students know how to</p> <ul style="list-style-type: none"> <li>- look for literature independently</li> <li>- use statistical methods for analysing experimental data and molecular-biological databases</li> <li>- maintain a laboratory journal</li> <li>- discuss the basic of scientific practice</li> <li>- analyse and discuss micro-biological and biotechnological publications</li> <li>- draft, write and discuss biotechnological presentations and publications</li> <li>- are able to articulate themselves well in the context of natural scientific topics, both in written and spoken form</li> <li>- give scientific presentations</li> <li>- actively participate in scientific discussions</li> <li>- use new experimental and analytical methods in the areas of biotechnology and microbiology</li> </ul>
<b>Literature Research (1501-521)</b>	
Person(en) verantwortlich	Prof. Dr. Herbert Schmidt
Lehrform	Übung
SWS	2
Inhalt	<p>Introduction to literature research (internet, library, interlibrary loan)</p> <p>Introduction to the analysis of statistical experimental data</p> <p>Exemplary display of molecularbiological databases for finding new or improving known proteins</p>
Anmerkungen	This course is compulsory for all students of this MSc, also for those who have successfully completed the module Einführung in wissenschaftliches Arbeiten (Bachelor's programme Lebensmittelwissenschaft und Biotechnologie) (1502-020).
<b>Scientific Publications (1501-522)</b>	
Person(en) verantwortlich	Prof. Dr. Herbert Schmidt
Lehrform	Seminar mit Übung
SWS	4

Inhalt	<p>Introduction, theory and practice of scientific publications and presentations</p> <p>Students are given a topic / review &amp; publication</p> <p>Preparation and independent presentation of a ca. 30-minute scientific presentation on a publication in the area of food microbiology and biotechnology with ensuing discussion</p>
<b>Introduction in Microbiological and Enzymatic Methods (1501-523)</b>	
Person(en) verantwortlich	Prof. Dr. Herbert Schmidt
Person(en) begleitend	Dr. Agnes Weiß, Dr. rer. nat. Elisabeth Hauser
Lehrform	Praktikum
SWS	2
Inhalt	<p>The students learn:</p> <ul style="list-style-type: none"> <li>- Sterile working techniques</li> <li>- Factorial growth kinetics</li> <li>- Determination of food ingredients (e.g. ethanol, glucose, fructose, sucrose, nitrate, citrate) by enzymatic methods</li> <li>- Determination of enzyme activities in food</li> <li>- To protocol experiments</li> <li>- Using statistical methods for analysing experimental data</li> </ul>
Literatur	Henniger, G. (2003) Enzymatic techniques for authenticating food components in Lees, M. (ed.) Food Authenticity and Traceability, CRC Press, 239-274

## **Modul: Soft Matter Science I - Food Rheology and Structure (1505-500)**

Modulverantwortung	Prof. Dr.-Ing. habil. Jörg Hinrichs, Dr. Stefan Nöbel, Prof. Dr. Bernd Hitzmann
Bezug zu anderen Modulen	Requirement for participation in the elective module "Innovative Dairy Technology"
Teilnahmevoraussetzungen	Scientific background in mathematics, physics and chemistry
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	1. Semester
Dauer des Moduls	4 Wochen (Block 4)
Verbindlichkeit	Pflicht
Studienleistung	attendance in practical course, laboratory reports, seminar presentation



Prüfungsleistung	Exam (80 % of total), seminar (20% of total) and practical seminar (to pass)
Modulprüfung	30 minute oral or 120 minute written exam on the contents of the lecture (80 % of total), seminar (20% of total) and practical seminar (to pass)
Prüfungsdauer	120 Minuten
Arbeitsaufwand	96 h attendance + 113 h independent study= 210 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	The students learn the basic principles of food structure and rheology. They gain an awareness of the various measurement technologies used to define the structure of complex food matrices. They design and conduct experiments, including standard methods, and perform data analysis. They work in small groups to characterise food systems and also learn about process modelling. They become familiar with presenting their work through written laboratory reports and oral presentations.
Anmerkungen	Maximum number of participants: 45
<b>Food Systems: Looking Beyond Rheology and Structure (1505-501)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. habil. Jörg Hinrichs, Prof. Dr. Bernd Hitzmann
Lehrform	Vorlesung
SWS	2
Inhalt	Principles of structural, mechanical, and dynamic characteristics of food systems. Basic information and fundamental terms in rheology, measurement technology for different food matrices, mechanical strain, dynamic rheology. Measuring systems and principles, methods in structure analysis, analysis of measurement data and modelling.
Literatur	Scientific literature, doctoral theses, publications from the department, textbooks in the departmental library.
<b>Literature Seminar: Structural Models for Food Systems (1505-502)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. habil. Jörg Hinrichs, Prof. Dr. Bernd Hitzmann
Lehrform	Seminar
SWS	2
Inhalt	Evaluation of publications and research contributions. Analysing scientific literature, presenting and discussing one topic.
Literatur	Scientific literature / library – additional literature, research journals
Anmerkungen	Lecture, including principles, methods, conclusion.
<b>Practical Course on Rheology and Structure (1505-503)</b>	
Person(en) verantwortlich	Prof. Dr.-Ing. habil. Jörg Hinrichs, Prof. Dr. Bernd Hitzmann
Lehrform	Übung

SWS	2
Inhalt	Practical course on food rheology and structure.
Literatur	Scientific literature, collection of methods, scientific publications and research articles
Anmerkungen	Student groups of 3 to 6 people

## Modul: Soft Matter Science II - Food Physics (1507-510)

Modulverantwortung	Prof. Dr. Jochen Weiss
Bezug zu anderen Modulen	Second part to Soft Matter I - Food Rheology and Structure
Teilnahmevoraussetzungen	Admission to a Master's program. Basic knowledge in physical chemistry and mathematics.
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 1)
Verbindlichkeit	Pflicht
Studienleistung	Laboratory presentation, Laboratory work
Prüfungsleistung	Klausur, Referat/Vortrag: 3-min. Talk, Poster presentation, Poster
Modulprüfung	Klausur (75%), optional mündliche Prüfung, Vortrag (10%), Poster mit Präsentation (15%)
Prüfungsdauer	90 Minuten
Arbeitsaufwand	64 h Präsenzzeit + 146 h Eigenanteil = 210 h Arbeitsaufwand
Fachkompetenzen / Lern- und Qualifikationsziele	Upon completion of the module, students are expected to have gained knowledge of physical phenomena that play a role in food systems. The students are able to demonstrate an understanding of (i) molecular material science approach to food systems, and (ii) structure-function relationships in matrices composed of proteins, lipids, and carbohydrates, and (iii) the operating principles of advanced physical analytical techniques as well as their use in the analysis of complex food structures. The students are able to apply principles of molecular mass transport, solution thermodynamics, phase transitions, and molecular interactions to solve problem-oriented case studies in foods. Furthermore, the students are able to explain, evaluate, and communicate concepts and results to their peers and professionals.
Schlüsselkompetenzen	Upon completion of the module, students are able to work as a part of a team, and develop stronger communication skills by completing assignments and designing clear and well-organized presentations, posters and flash talks. The students are expected to apply critical

	and analytical thinking to solve food physics-related challenges. Students are able to improve their written and oral English skills.
Anmerkungen	Maximum number of participants: 50
<b>Soft Matter Science II - Food Physics (1507-511)</b>	
Person(en) verantwortlich	Prof. Dr. Jochen Weiss
Lehrform	Vorlesung mit Übung und Praktikum
SWS	4
Inhalt	This module reviews fundamental concepts of food physics, and aims to deliver knowledge of principles of physical phenomena (e.g., mass transport, solution thermodynamics, molecular and particle interactions, and phase transitions) in complex food matrices. Case studies highlight the connection between the theory and practical relevance. Student assignments aim to promote knowledge transfer and enable the students to apply the scientific concepts and scientific literature. These assignments involve calculation exercises, and laboratory studies that will be also orally presented during the module. Moreover, individual flash talks and poster presentations based on current papers in the area of food physics will be presented in a formal scientific setting of a mini-conference during the module.
Literatur	Principles of Colloid and Surface Chemistry, CRC Press,1997, ISBN: 978-0824793975 Polymer Chemistry, CRC Press, 2007, ISBN: 978-1574447798 Phase Transitions in Foods (1. Ed), Academic Press,1995, ISBN: 978-0125953405 Phase Transitions in Foods (2. Ed) Academic Press, 2016, ISBN: 978-0124080867 Biophysics: An introduction, Springer, 2012, ISBN: 978-3-642-25211-2 Biophysics, Springer, 2002, ISBN: 978-1-4020-0218-2

## **Modul: Technologie pflanzlicher Lebensmittel II (1504-430)**

Modulverantwortung	N.N.
Bezug zu anderen Modulen	Einführung in Modul "Technologie pflanzlicher Lebensmittel I"
Teilnahmevoraussetzungen	-
Sprache	deutsch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Semesterlage	2. Semester
Dauer des Moduls	4 Wochen (Block 3)
Verbindlichkeit	Wahl

Modulprüfung	2-stündige schriftliche Prüfung, Kolloquium (20 Minuten)
Arbeitsaufwand	56 h Präsenz + 132 h Eigenanteil = 188 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	<p>Die Studierenden</p> <ul style="list-style-type: none"> <li>- führen im Rahmen des Praktikums im Technikum des Lehrstuhls unter industrienahen Bedingungen Versuche zur Verarbeitung pflanzlicher Lebensmittel durch</li> <li>- lernen den Umgang mit den hierfür notwendigen Maschinen und Apparaten kennen</li> <li>- bearbeiten in Kleingruppen komplette Prozesse vom Einsatz der Rohware bis zum fertig verpackten Produkt einschließlich prozessbegleitender Analysen</li> <li>- erwerben in der Vorlesung vertiefte Kenntnisse über alkaloidhaltige Rohwaren (Kaffee, Tee, Kakao und andere), deren Aufbereitung in den Ursprungsländern und Weiterverarbeitung in den Verbraucherländern</li> </ul>
Anmerkungen	Anzahl Teilnehmerplätze: 30 Anmeldung zur Teilnahme am Modul: Ab Mitte des Wintersemesters bis zu Beginn der Vorlesungszeit im Sommersemester durch Aushang am Schwarzen Brett des Fachgebietes.
<b>Alkaloidhaltige Lebensmittel (1504-431)</b>	
Person(en) verantwortlich	N.N.
Lehrform	Vorlesung
SWS	1
Inhalt	<ul style="list-style-type: none"> <li>- Kaffee</li> <li>- Tee</li> <li>- Kakao</li> <li>- Weitere alkaloidhaltige Lebensmittel (Guaraná, Maté usw.)</li> </ul>
Literatur	Skripte mit speziellen Literaturempfehlungen für die einzelnen Themengebiete
<b>Technologisches Praktikum (1504-432)</b>	
Person(en) verantwortlich	N.N.
Lehrform	Praktikum
SWS	3
Inhalt	<ul style="list-style-type: none"> <li>- Haltbarmachung durch Erhitzen (Pasteurisation, Sterilisation) und Gefrieren (Nasskonserven, Tiefkühlprodukte)</li> <li>- Alkoholfreie Getränke (Fruchtsaft, -nektar)</li> <li>- Speiseöl</li> <li>- Gelierprodukte (Konfitüre, Fruchtzubereitung)</li> </ul>
Literatur	Skripte mit speziellen Literaturempfehlungen für die einzelnen Themengebiete

## Modul: Technologie pflanzlicher Lebensmittel III (1504-440)

Modulverantwortung	PD Dr. Dietmar Kammerer, Hon.-Prof. Hans-Ulrich Endreß, apl. Prof. Dr. rer. nat. Herbert Buckenhüskes, apl. Prof. Dr. rer. nat. Florian Stintzing
Bezug zu anderen Modulen	Technologie pflanzlicher Lebensmittel I und II
Teilnahmevoraussetzungen	Erfolgreicher Abschluss des Moduls "Technologie pflanzlicher Lebensmittel I"
Sprache	deutsch
ECTS	7,5
Angebotshäufigkeit	jedes WS
Semesterlage	3. Semester
Dauer des Moduls	4 Wochen (Block 4)
Verbindlichkeit	Wahl
Arbeitsaufwand	56 h Präsenz + 132 h Eigenanteil = 188 h workload
Fachkompetenzen / Lern- und Qualifikationsziele	Die Studierenden - lernen Spezialgebiete aus dem pflanzlichen Bereich mit Relevanz für die gesamte Lebensmitteltechnologie kennen - werden durch Experten aus der Wirtschaft unterrichtet und an industrielle Fragestellungen herangeführt - lernen entsprechende Betriebe im Rahmen von Exkursionen kennen - erhalten weitere Anschauung durch Demonstrationen/ Übungen in den Vorlesungen oder vor Ort in den Betrieben - erhalten eine Orientierung zum Einstieg in die Masterarbeit
Anmerkungen	Anzahl Teilnehmerplätze: 30 Anmeldung zur Teilnahme am Modul: Ab Mitte des Wintersemesters bis zu Beginn der Vorlesungszeit im Sommersemester durch Aushang am Schwarzen Brett des Fachgebietes. Bei diesem Modul handelt es sich um ein nicht-endnotenrelevantes Modul.

### Technologie pflanzlicher Lebensmittel III (1504-441)

Person(en) verantwortlich	PD Dr. Dietmar Kammerer, Hon.-Prof. Hans-Ulrich Endreß, apl. Prof. Dr. rer. nat. Herbert Buckenhüskes, apl. Prof. Dr. rer. nat. Florian Stintzing
Person(en) begleitend	Matthias Saß, Dr. Hartmut Rohse, Dr. Katrin Schütz-Morsch
Lehrform	Vorlesung mit Übung und Exkursion
SWS	4
Inhalt	- Zusatzstoffe und ausgewählte Ingredienzien (insbesondere Gewürze) (Buckenhüskes) - Hydrokolloide (Gelier- und Verdickungsmittel unter besonderer Berücksichtigung des Pektins) (Endreß) - Süßwarentechnologie (Rohse)

	<ul style="list-style-type: none"> <li>- Funktionelle Getränke (Schütz-Morsch, Saß)</li> <li>- Färbende Lebensmittel (Stintzing)</li> <li>- Einführung in die Anfertigung von Projekt- und Masterarbeiten, Erlernen entsprechender Arbeitstechniken, Vorstellung von Forschungsschwerpunkten (Carle)</li> <li>- Exkursionen</li> </ul>
Literatur	Skripte mit speziellen Literaturempfehlungen für die einzelnen Themengebiete

## **Modul: UNIcert III English for Scientific Purposes (1000-040)**

Modulverantwortung	Prof. Dr. rer. nat. Lutz Fischer
Teilnahmevoraussetzungen	Scoring at least 85 points in the Language Center's entrance examination OR a UNIcert II certificate or equivalent proof of English language proficiency OR being enrolled in an English-language Master's program at the Faculty of Natural Sciences.
Sprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes Semester
Semesterlage	1. Semester
Dauer des Moduls	2 Semester
Verbindlichkeit	Wahl
Studienleistung	Regular attendance, active participation, other (see individual course descriptions at <a href="https://spraz.uni-hohenheim.de/kurse">https://spraz.uni-hohenheim.de/kurse</a> )
Modulprüfung	UNIcert III examination (240 minutes total): 180 minutes written exam, 30 minutes listening comprehension, 30 minutes oral exam
Arbeitsaufwand	225 h
Fachkompetenzen / Lern- und Qualifikationsziele	<p>Upon successful completion of this module, the English language proficiency of the students corresponds to the level C1 of the Common European Framework of Reference for Languages.</p> <p>For details on the competencies you acquire beyond language proficiency, please read the individual course descriptions at <a href="https://spraz.uni-hohenheim.de/kurse?&amp;L=1">https://spraz.uni-hohenheim.de/kurse?&amp;L=1</a>.</p>
Anmerkungen	You need to register for the UNIcert III courses. Information on how to register is available at <a href="https://spraz.uni-hohenheim.de/anmeldung?&amp;L=1">https://spraz.uni-hohenheim.de/anmeldung?&amp;L=1</a> .
<b>UNIcert III English for Scientific Purposes (1000-041)</b>	
Lehrform	Kurs
SWS	8

Inhalt	<p>Scientific Writing (2 SWS)          “This course focuses on written communication in the scientific world using English. The primary emphasis is on the structure and vocabulary of a scientific paper/article. Printed materials include articles and papers from each student's area of interest, as well as vocabulary, writing, and grammar exercises.”</p> <p>Critical Thinking (2 SWS)          “This course is relevant for anyone who would like to improve the way they read and deal with academic and scientific texts. Research based reading will cover strategies for improving reading techniques and skills such as speed reading and scanning academic texts for pertinent information. It will give you the opportunity to identify text types, critically assess and analyze their content to identify their main points, and distinguish fact from opinion.”</p> <p>Intercultural Communication (2 SWS)          “Communication between two members of the same cultural community takes place within the framework of a common language and against a common socio-cultural background. International communication may thus fail, or be less satisfactory than it could be, not only because of language problems but also because the participants have insufficient knowledge of each other's cultural background and an undeveloped awareness of what is unique to their own cultural background.”</p> <p>Scientific Reading and Discussion (2 SWS)          “This course is particularly important for science students, as many leading textbooks and the majority of scientific research articles are written in English. Instructor feed-back will be given to each student's grammar, vocabulary, and fluency problems.”</p>
Anmerkungen	Registration: <a href="https://spraz.uni-hohenheim.de/anmeldung">https://spraz.uni-hohenheim.de/anmeldung</a>