Study Plan and Module Catalogue

for the Master Programm

MSc Food Process and Product Engineering (MSc FPPE)

Stiftung Tierärztliche Hochschule Hannover (TiHo)

in cooperation with

Deutsches Institut für Lebensmitteltechnik e. V.

(DIL)

28.07.2022

Study Plan and module catalogue

1 Study plan

Note:
TiHo = Module is performed at TiHo in Hannover and / or online
DIL: = Module is performed at Artland Campus / DIL in Quakenbrück

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Sem.	Food Process and Product Engineering (MSc)					
1 (30 ECTS)	Process Engineering and Advanced Technologies (6 ECTS, DIL)	Advanced Analytics for Food Production (6 ECTS, DIL)	Information skills, general research skills (5 ECTS, TiHo	Foodborne Zoonoses (5 ECTS, TiHo)	Environmental and Sustainability Management (5 ECTS, DIL)	1 Waus 1-8 (3 ECTS)
2 (30 ECTS)	Product Engineering (6 ECTS, DIL)	Technology Transfer (6 ECTS, DIL)	Microbial Ecology (6 ECTS, DIL)	Statistics and Data Science (6 ECTS, TiHo)	2 W aus 1-8 (2x3=6 ECTS)	
3 (30 ECTS)	Food Biotechnology (6 ECTS, DIL)	Intensive Case Study (18 ECTS, TiHo + DIL)			2 W aus 1-8 (2x3=6 ECTS)	
4 (30 ECTS)	Master Thesis (30 ECTS, TiHo + DIL)					

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4 Liste der Wahlpflichtmodule W1 bis W8

W1	W2	W3	W4
Business innovation and Entrepreneurship in food technology (3 ECTS, DIL)	Digitalization in food processing (3 ECTS, DIL)	Food quality and food safety (Food poisoning) (3 ECTS, TiHo)	Process Economy (3 ECTS, DIL)
W5	W6	W7	W8
Consumer science (3 ECTS, DIL)	Lean Management (3 ECTS, DIL)	Food Sensomic (3 ECTS, TiHo)	Quality Management in Food Production / Public Health (3 ECTS, TiHo)

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6 Table of modules

Modules and related lessons	Semester	examination achievements and types	Study achievements	Student workload (in time hours)		ECTS-Points	Module representatives	Module representatives (transitional)
				Attendance time, (h)	Self study, (h)			
Module 1-9: compulsory, you need all of them								
Module 1 - Process Engineering and Advanced Technologies	DIL					6 =180 h	Professur „Food Technology and Digitalization“	Dr. Volker Lammers / Dr. Kemal Aganovic (DIL)
Lecture	1	Written exam		42	78			
Practical course	1	Practical course report		20	40			
Module 2 - Advanced Analytics for Food Production	DIL					6 = 180 h	Professur “Food Physics” und Professur “Nutritional Biochemistry”	Dr. Dana Middendorf / Dr. Xiaoai Guo / Dr. Andreas Juadjur (DIL)
Lecture	1	Written exam		42	78			
Practical course	1	Practical course report		20	40			
Module 3- Statistics and Data Science	TiHo					6 =180 h	Prof. Klaus Jung (TiHo)	Prof. Klaus Jung (TiHo)
Lecture	2	Written exam (2 h)		28	28			
Tutorial	2	Exercises		28	96			
Module 4 – Foodborne Zoonoses	TiHo					5 =150 h	PD Dr. Nadja Jeßberger (TiHo)	PD Dr. Nadja Jeßberger (TiHo)
Lecture	1	Written exam (2 h)		28	122			
Module 5 – Environmental and Sustainability Management	DIL					5 =150 h	Professur “Food System Analysis”	Dr. Sergiy Smetana (DIL)
Lecture	1	Written exam		30	34			
Tutorial (Life Circle Assessment /LCA study)	1	LCA report, presentation		20	66			
Module 6 - Product Engineering	DIL					6 = 180 h	Professur „Food Technology and Digitalization“ und Professur “Food Physics”	Dr. Nino Terjung und Dr. Dana Middendorf / Dr. Xiaoai Guo (DIL)
Lecture	2	Written exam		42	78			
Practical course	2	Practical course report		20	40			
Module 7 - Technology Transfer						6 = 180 h	Professur „Food Technology	Dr. Kemal Aganovic (DIL)
Lecture	2	Schriftliche		42	78			

		Prüfu					and Digitalizatio n“	
Practical course	2	Practical course report		20	40			
Module 8 – Microbial Ecology	DIL					6 = 180 h	Professur “Microbial Ecology”	Dr. Christian Hertel (DIL)
Lecture	2	Written exam		42	138			
Module 9 - Information skills, general research skills	TiHo					5 =150 h	Prof. Sabine Leonhard-Marek (TiHo)	Prof. Sabine Leonhard-Marek (TiHo)
Tutorial	1	Article / paper		28	51			
Kolloquium	1	Scientific presentation (30 min)		20	51			
Module 10 – Food Biotechnology	DIL					6 =150 h	Professur “Nutritional Biochemistr y”	Dr. Christian Hertel (DIL)
Lecture	3	Written exam		20	40			
Practical course	3	Practical course report		40	80			
Module E1 –E8: Compulsory elective, you need 6 out of 9 modules								
Module E1 – Business innovation and Entrepreneurship in food technology	DIL					3 =90 h	Dr. Prateek Mahalwar (BIOWEG), Alexander Märdian (DIL)	Dr. Prateek Mahalwar (BIOWEG), Alexander Märdian (DIL)
Lecture	1	Presentation/ Pitch Deck		20	20			
Tutorial (Case study)	1	Business plan		10	40			
Module E2 – Digitalization in food processing	DIL					3 =90 h	Professur „Food Technology and Digitalizatio n“	NN
Lecture	2 or 3	Written exam		28	62			
Module E3 – Food Quality and Food Safety (Food Poisoning)	TiHo					3 =90 h	Prof. Madeleine Plötz (TiHo)	Prof. Madeleine Plötz (TiHo)
Lecture	1	Written project work (about 10 pages)		16	50			
Project work	1	Oral presentation about the project (30 min)		12	12			
Module E4 – Process Economy	DIL					3 =90 h	Professur “Food System Analysis”	Dr. Volker Heinz (DIL)
Lecture	1 or 2			14	20			
Tutorial (Case study)	1 or 2	Case study report/ presentation		16	40			
Module E5– Consumer	DIL					3	Dr. Adriano	Dr. Adriano

Science						=90 h	Profeta und Dr. Clara Mehlhose (DIL)	Profeta und Dr. Clara Mehlhose (DIL)
Lecture	2 or 3	Referat (30 min)		12	22			
Tutorial	2 or 3	Study work (about 10 pages)		16	40			
Module E6 – Lean Management	DIL					3 =90 h	NN	NN
Lecture	2 or 3	Written exam (1 h)		20	20			
Tutorial (case study)	2 or 3	Case study report/ presentation		10	40			
Module E7 – Food Sensomic	TiHo					3 =90 h	Dr. Lisa Siekmann (TiHo)	Dr. Lisa Siekmann (TiHo)
Lecture	2 or 3	Oral presentation about the project (30 min)		12	12			
Project work	2 or 3	Written projekt work (10 pages)		16	50			
Module E8 – Quality Management in Food Production/Public Health	TiHo					3 =90 h	PD Dr. Carsten Krischek (TiHo)	PD Dr. Carsten Krischek (TiHo)
Lecture	1, 2 or 3	Oral exam (30 min), study work (ca. 10 pages), (percentage study work of final mark 30 %)		28	62			
Intensive Case Study (compulsory)	TiHo / DIL					21 =630 h	Individuel	Individuel
Literature research / Writing	3	Exposé/Präsentation		2	100			
Practical course, review writing	3	Report/Review		240	240			
Colloquium	3	Präsentation Ergebnisse		2	46			
Master Thesis (compulsory)	TiHo/ DIL					30 =900 hModul		N.N.
Literature research / Writing	4	Exposé/Präsentation		3	142			
Practical course, review writing	4	Master thesis		343	343			
Colloquium	4	Oral exam		3	66			

7 Module descriptions

Note:
TiHo = Module is performed at TiHo in Hannover and / or online
DIL: = Module is performed at Artland Campus / DIL in Quakenbrück

7.1 Compulsory modules: You need all of them

7.1.1 Process Engineering and Advanced Technologies (DIL)

Process Engineering and Advanced Technologies (Module 1)					
Semester / place	**Frequency**	**Duration**	**Type**	**ECTS points**	**Student work load**
1, DIL	1x per year (each winter term)	Lecture during the whole semester (2h per week), Practical course 1x block week	Compulsory module	6	180h: 82h Attendance study, 98h Self-study

Requirements for participation	**Applicability**	**Prerequisite for the award of credit points** (Type / duration of the examination	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme FPPE	Use of the module in the MSc FPPE programme	Written exam und practical courses report (relevant for final mark), weighting 50/50 for the final mark	Lecture und Practical course	Professur „Food Technology and Digitalization“/ Dr. Volker Lammers / Dr. Kemal Aganovic (DIL)

Qualification goals
This module covers selected food processing methods and their side streams. The aim is to provide stu-dents with skills in the use of advanced technologies in addition to the fundamentals of engineering. In addi-tion to the established technologies, the focus is also on the use of novel technologies (e.g. pulsed electric fields, high pressure technology, shock waves, extrusion, ohmic heating, hydrolysis, etc.) for the treatment of foods (plant and animal products) and their side streams. In particular, the technologies presented are analyzed in terms of preservation and safety, food structuring, energy balance, sustainability, legal situation, product costs and potential savings as well as sales opportunities. After completing the module, students should be able to explain, design and implement process engineering concepts with special emphasis on food process engineering, energy economics as well as ecological and legal aspects.

Furthermore, students should be introduced to possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, smart sensors, machine learning, etc.).Furthermore, students should be shown possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, smart sensors, machine learning, etc.).

Teaching content
Lecture: • Functional principles and possible applications (incl. product examples) of selected technologies of food processing technology (mechanical, thermal and alternative processes, see below). • - Effects of the technologies on food and its components (structure, functionality, shelf life and safety) • - Comparison and evaluation of traditional (state-of-the-art) and modern (advanced) processes on the basis of selected case studies (e.g. pasteurisation vs. HPP treatment of juice) • - Sustainability and energy considerations • - Modern process technology (pulsed electric fields, high pressure treatment, shock waves, extrusion, ohmic heating) Practical course: • Mechanical Process Engineering: Mischen/Homogenisieren, Trennen (Slicer) • Thermal Process Engineering: Trocknung, Verkapselung (Ventilex) • Advanced Technologies: HPP, PEF
Recommended previous knowledge
Basics of process engineering, traditional processes in food processing

Courses		
Teacher	**Titel of courses**	**Hours**
Professur „Food Technology and Digitalization“ / Dr. Volker Lammers (DIL)	Mechanical Process Engineering – Lecture	14
Professur „Food Technology and Digitalization“ / Dr. Volker Lammers (DIL) / Dr. Kemal Aganovic (DIL)	Process Engineering & Advanced Technologies– Practical course	40
Professur „Food Technology and Digitalization“ / Dr. Volker Lammers	Thermal Process Engineering – Lecture	14

(DIL)		
Professur „Food Technology and Digitalization“ / Dr. Kemal Aganovic (DIL)	Advanced Technologies – Lecture	14

7.1.2 Advanced Analytics for Food Production (DIL)

Advanced Analytics for Food Production (Module 2)					
Semester / place	**Frequency**	**Duration**	**Type**	**ECTS points**	**Student work load**
1, DIL	1x per year (each winter ssemester)	Lecture whole semester (2h per week), practical course 1x block week	Compulsory module	6	180h: 82h Attendance study, 98h Self-study

Requirements for participation	**Applicability**	**Prerequisite for the award of credit points** (Type / duration of the examination	**Teaching and learning methods**	**Module representative**
Bachelor of Science or Bachelor of Engineering in Food Technology etc.., Admission to the programme	Use of the module in the MSc FPPE programme	Written exam und practical courses report (relevant for final mark), weighting 50/50 for the final mark	Lecture and Practical course	Professur “Food Physics” / Dr. Dana Middendorf / Dr. Xiaoai Guo und Professur „Nutritional Biochemistry“ / Dr. Andreas Juadjur (DIL)

Qualification goals
After completing the module, students will be familiar with the various possibilities for characterizing food substance systems and will be able to evaluate them in terms of their suitability for solving specific problems. This module therefore provides knowledge of selected methods for the characterization of food products, their ingredients and side streams, with the help of which the relationships between structures and properties as well as functionality can be derived. Furthermore, online and inline measurement methods such as particle measurement technology and their integration into production systems are covered. In particular, through the interdisciplinary teaching of analytical methods for content characterization and for the characterization of functionality and food structures in combination with the knowledge imparted in the module "Food Biotechnology" with regard to biotechnological analytics, the students are provided with an analytics "toolbox". The selection of the respective tools will then be practiced by means of practical examples during the laboratory course. This toolbox will then be used in the "Product Engineering" module in relation to the manufacture of products and will thus be further deepened in practical work. Furthermore, students will be introduced to possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, smart sensors, machine learning, etc.).

Teaching content
The methods are taught in a practical and interdisciplinary manner using the example of various foods and food substance systems such as emulsions, foams, suspensions. Methods for content characterization: • Wet chemical methods for the determination of fat, proteins and carbohydrates. • Chromatography (e.g. HPLC, GC, DC, HPTLC) • Spectroscopy (e.g. UV, Vis, IR, Raman, MS, NMR) • Separation techniques by polarity, size and charge: (gel) electrophoresis (including SDS-PAGE, IEF), gel permeation chromatography a4F, extraction, precipitation, CCC. • Protein characterization & enzymology • coupling techniques Methods for characterization of food structure and functionality: • Microscopy (including light microscopy, confocal laser scanning microscopy (CLMS), • Scanning electron microscopy (SEM), transmission electron microscopy (TEM), energy dis-persive X-ray analysis (EDX), atomic force microscopy (AFM): functional principles, areas of application, sample preparation, knowledge gain, possibilities of image evaluation) • Thermal analysis (dynamic and static methods, including differential scanning calorimetry (DSC), dynamic mechanical/thermomechanical analysis (T/DMA), thermogravimetry (TGA)) • Tensiometry and polarity measurements (including principles of force measurements using stirrups, rings, plates, and optical measurements using contact angle, pendant drop/spinning drop methods) • Particle measurement techniques (modern off-line/at-line/on-line/in-line measurement methods and devices such as un-mediated counting methods, mediated counting methods/image analysis, separation methods, spectroscopy methods, etc.; presentation of measurement results and particle characteristics of crystals, primary particles, agglomerates or aggregates) • Rheology, rheometry and texture analysis (including elastic properties, viscous properties (flow behavior, viscoelasticity, rheological measurement systems (rotational rheometer, oscillation test), texture investigation)). Lab Course: • Chromatographic separation methods and spectroscopy Methods for characterization of structure and functionality of foods
Recommended previous knowledge
Basic knowledge and practical experience in laboratory work techniques and basic analytical investigation methods.

Courses		
Teacher	**Titel of courses**	**Hours**
Professur „Nutritional Biochemistry“ / Dr. Andreas Juadjur (DIL)	Methods for ingredient characterisation - Lecture	20

Professur “Food Physics” / Dr. Dana Middendorf (DIL) / Dr. Xiaoai Guo (DIL)	Methods for characterising the structure and functionality of food - Lecture	22
Professur “Food Physics” / Dr. Andreas Juadjur (DIL) / Dr. Dana Middendorf (DIL) / Dr. Xiaoai Guo (DIL)	Methods for ingredient characterisation and structure and functionality of food - Practical course	40

7.1.3 Statistics and Data Science (TiHo)

Statistics and Data Science (Module 3)					
	Frequency	**Duration**	**Type**	**ECTS points**	**Student work load**
2, TiHo	1x im Jahr (jedes Wintersemester)	Lecture whole semester (2 h per week), tutorial (2 h per week)	Compulsory module	6	180h: 56h Attendance study, 124h Self-study

Requirements for participation	**Applicability**	**Prerequisite for the award of credit points** (type/ duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology etc., Admission to the programme FPPE, Veterinary medicine or MSc Animal Biology and Biomedical Sciences at TiHo	Use of the module in the MSc FPPE programme, Enrolment in the courses for students oft he TiHo possible.	Written exam (2 h) and exercises (relevant for final mark), weighting 50/50 for the final mark.	Lecture and tutorial	Prof. Klaus Jung (TiHo)

Qualification goals
Students are able to statistically plan and design experiments and studies, and to analyse the resulting data, and to apply this knowledge for their professional scientific questions. Students will acquire knowledge in probability theory, descriptive and inductive statistics, as well as in standard methods of regression analysis, analysis of variance and nonparametric analysis. Additionally, the students are able apply supervised and unsupervised learning methods, to judge the performance of learning models, and to apply further data science methods such as data mining and data fusion. The students will be able to select appropriate methods for data analysis from the scientific perspective of questions in food process and product engeneering.

Teaching content
Statistics: • Probability theory and statistical distributions • Descriptive statistics and graphics • Inferential statistics / estimation & test theory • Correlation analysis / regression models / generalized linear models • Design of experiments and analysis of variance / power analysis • Nonparametric methods

Data Science:

- Supervised and unsupervised learning methods
- Performance measures / validation methods
- Data mining
- Data fusion
- Dimension reduction
- Outlier detection

Recommended previous knowledge

Courses

Teacher	Titel of courses	Semester hours per week
Prof. Klaus Jung (TiHo)	Statistics and Data Science - Lecture	2
Prof. Klaus Jung (TiHo)	Statistics and Data Science - Tutorial	2

7.1.4 Foodborne Zoonoses (TiHo)

Foodborne Zoonoses (Module 4)					
Semester / place	**Frequency of the module**	**Duration**	**Type**	**ECTS-points**	**Student workload**
1, TiHo	1x per year (every winter semester)	Oral lecture whole semester (2 h per week)	Compulsory module	5	150 h: 28 h in presence, 122 h self study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points (type / duration of examination)**	**Teaching and learning methods**	**Responsible person for the module**
Bachelor of Science or Bachelor of Engineering in Food Technology or similar, admission to the FPPE, Veterinary Medicine or Animal Biology and Biomedical Sciences program at TiHo	Use of the module in the FPPE program, occupancy can be taken by TiHo students (Veterinary Medicine, Animal Biology, Biomedical Sciences)	Written examination (2 h)	Lecture	PD Dr. Nadja Jeßberger (TiHo)

Qualification goals
The students are aware of the different microorganisms, which occur as natural contaminants in foodstuffs. They understand the correlation between food hygiene and food safety, and acquired profound scientific knowledge regarding methods for identification and prevention of microorganisms and viruses in foods. Furthermore, the students learned possibilities for the integration of digital technologies (for example IoT, blockchain, cloud-computing, intelligent sensors, and machine learning) into these processes.

Teaching contents
Applied Microbiology: - Basic contents of microbiology, molecular biology and biotechnology - pathomechanisms of bacterial pathogens - cultivation of microorganisms (bacteria, yeast, fungi) in different scales - fungal model systems and their biology - implementation of molecular biological and biochemical research methods for the detection of microorganisms (for example microorganisms with special importance for foods, effects of microbial contamination for the product, PCR techniques for the detection of microorganisms, global analysis methods such as transcriptomics

or proteomics, immunodetection (Western blot), characterization of enzymes with proteinbiochemical methods, etc.)
- implementation of molecular biological and biochemical research methods for microbial engineering (for example determination of parameters relevant for production, expression and purification of proteins in homologous or heterologous host systems, protein secretion, generation of mutants (strain optimization), molecular biological methods for protein engineering and for directed evolution (random or directed mutagenesis), whole cell biocatalysis, biotransformation, implementation of different enzymes in biotechnology, production of amino acids and further microbial products, regulation of microbial (eukayotic and prokaryotic) expression and production processes, posttranscriptional regulation, etc.)

Virology:
- basic virology
- introduction to infection and epidemics teachings
- pathomechanisms of viruses
- basics of infection immunology and immune prophylaxis

Recommended previous knowledge
Basic knowledge in the field of microbiology, micro- and molecular biological analysis methods.

Courses		
Teacher	**Title of the lecture/ seminar/ course**	**Hours in total**
Jeßberger	Food microbiology - bacteria (lecture)	20
Jeßberger	Food microbiology - fungi (lecture)	4
Jeßberger	Food microbiology - viruses (lecture)	4

7.1.5 Environmental and Sustainability Management (DIL)

Environmental and Sustainability Management (Module 5)					
Semester / place	**Frequency of the module**	**Duration**	**Type**	**ECTS points**	**Student work load**
1, DIL	1x per year (each winter semester)	Lecture whole semester (1h per week), tutorial 1x block week (4 days)	Compulsory module	5	150h: 50h Attendance study, 100h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points (type / duration of examination)**r	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme	Use of the module in the MSc FPPE programme	Written exam und LCA-Study (relevant for final mark), weighting 50/50 for the final mark	Lecture und Tutorial	Professur „Food System Analysis“ / Dr. Sergiy Smetana (DIL)

Qualification goals
The aim of the module is to enable students to recognize and assess fundamental causes and mechanisms of environmental pollution and resource use and to gain an overview of the social regulatory mechanisms. Building on this, the module aims to provide students with the knowledge and skills to optimize operational processes, derive innovations in a targeted manner, and improve economic efficiency through resource efficiency. In addition, the students should be able to independently carry out an LCA for a production process or similar and to understand which information is necessary for this and which recommendations for action can be derived from the results. Furthermore, students should be shown the possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, intelligent sensors, machine learning, etc.).

Teaching content
Overview of the main pressures on the environmental media and the applicable regulations and standards, basic instruments of corporate environmental management, determination and evaluation of the environmental performance of their own organization, the interaction of environmental management tools with other focused management systems, problems of the implementation of an environmental management system, production-technical-scientific, economic, social and environmental aspects of food production, elaboration and

communication of knowledge for the food sector and the management of environmental issues, ensur-ing sustainable food production in harmony with the environment, the preparation of a life cycle assessment (LCA) of production and manufacturing processes and of the company as a whole. Tutorial: Development of an LCA (Life Cycle Assessment) using a production process or similar as an example.
Recommended previous knowledge
Basic knowledge in the field of sustainability

Courses		
Teacher	**Titel of courses**	**Hours**
Professur „Food System Analysis“ / Dr. Sergiy Smetana (DIL)	Environmental management - Lecture	10
Professur „Food System Analysis“ / Dr. Sergiy Smetana (DIL)	Life Cycle Assessment - Lecture	10
Professur „Food System Analysis“ / Dr. Sergiy Smetana (DIL)	Life Cycle Assessment - Tutorial	20
Professur „Food System Analysis“ / Dr. Sergiy Smetana (DIL)	Sustainability of Food Systems - Lecture	10

7.1.6 Product Engineering (DIL)

Product Engineering (Module 6)					
Semester / place	**Frequency of the module**	**Dauer**	**Type**	**ECTS points**	**Student work load**
2	1x per year (eache summer semester)	Lecture whole semester (2h per week), practical course 1x block week	Compulsory module	6	180h: 62h Attendance study, 118h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** (type / duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o. Ä., Admission to the programme	Use of the module in the MSc FPPE programme	Written exam und practical courses report (relevant for final mark), weighting 50/50 for the final mark	Lecture und Practical course	Professur „Food Technology and Digitalization“ / Dr. Nino Terjung und Professur „Food Physics“ / Dr. Dana Middendorf / Dr. Xiaoai Guo (DIL)

Qualification goals
This module covers the four major components of food - proteins, fats, carbohydrates and water - and the side streams from their production. The module shows students the possibilities and limitations of product formulation. Understanding the relationship between the selection and origin of raw materials (e.g., plant and animal, country and region specific), their quality and functionality in terms of their production and pro-cessing (technology selection), as well as their utilization and the use of corresponding side streams is es-sential. Furthermore, students will be shown possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, smart sensors, machine learning, etc.).

Teaching content
Food Properties / Disperse Systems: Based on the knowledge acquired in semester 1 (Process Engineering and Advanced Technologies, Advanced Analystics), the fundamental relationships between the functional properties of foods and their ingredients with regard to essential quality characteristics (including stability/durability, sensory properties and processability) are discussed. For this purpose, the relevant aspects are highlighted using concrete examples (disperse

systems) from different product groups.

- Dispersions: Stabilization, flocculation and coagulation
- emulsions: Formation, stabilization by surfactants, interfacial and surface tension, creaming and sedimentation, coalescence; stabilization by proteins and/or solid particles like Pickering emulsions
- foams: formation, structure, coalescence, drainage, stability, defoamers
- interactions, PGV, rheological properties, etc.

Furthermore, the analytical capabilities to characterize these product groups will be developed using the Analytics "Toolbox" learned in Module 2 "Advanced Analytics".

Product development:
Practical examples will be used here to show how new added value can be achieved from the main components of food products as well as from side streams of existing food production. Among other things, the phases as well as the strategic possibilities of a product development will be illuminated. In addition, process management in product development (internal organization) and the development of product concepts will be taught and the competition for innovations in the food sector will be addressed. Examples of product innovations as well as methods of idea generation and evaluation will be included. Based on these, limits and possibilities as well as aspects of biotechnology and further processing will be dealt with.
Specifically, product development is taught in three parts/sections:

1. basics of product development: influence of salt, pH, temperature, quantity in solution, etc. on proteins, polysaccharides and lipids; interactions of the three components depending on concentrations and further, above mentioned parameters (salt, pH, etc.).
2. product development based on practical examples: e.g. vegan tuna, egg and bacon or salt-reduced raw sausage - from the idea to the finished product
3. own solution approaches for concrete problems: Students will be guided to develop their own concepts for the development of given products (e.g. vegan scalded sausage or fish sticks); the practical implementation will take place during the internship

Laboratory course:

- Produce special case of a requested product example (Technikum or Lab DIL).
- Connected analysis by means of Analytics "Toolbox" (structure and functionality characterization)

Recommended previous knowledge
Fundamentals of food production and process engineering, etc., successfully completed modules 1 and 2.

Courses		
Teacher	**Titel of courses**	**Hours**
Professur “Food Physics” / Dr. Dana Middendorf (DIL) / Dr. Xiaoai Guo (DIL)	Food Properties / Disperse Systems - Lecture	22
Professur „Food Technology and Digitalization“ / Dr. Nino Terjung (DIL)	Product Development – Lecture / Tutorial Fallbeispiel	20

Professur „Food Technology and Digitalization“ / Dr. Nino Terjung (DIL) / Dr. Dana Middendorf (DIL) / Dr. Xiaoai Guo (DIL)	Food Properties / Disperse Systems and Product Development - Practical course	20

7.1.7 Technology Transfer (DIL)

Technology Transfer (Module 7)					
Semester / place	**Frequency of the module**	**Dauer**	**Type**	**ECTS points**	**Student work load**
2, DIL	1x per year (each summer term)	Lecture whole semester (2h per week), practical course 1x Block week	Compulsory module	6	180h: 62h Attendance study, 118h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** (type / duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme	Use of the module in the MSc FPPE programme	Written exam und Practical courses report (relevant for final mark), weighting 50/50 for the final mark	Lecture und Practical course	Professur „Food Technology and Digitalization“ / Dr. Kemal Aganovic (DIL)

Qualification goals
Within the module, the development and implementation of a product from the idea through the production process and plant design to the finished product are to be illustrated. Various phases such as idea generation, proof of concept, transfer of research and development results to the production standard, implementation of the processes, design of the production facilities and a possible scale-up are covered. Students are thus shown which steps are required in the implementation of an idea. In addition, the scaling from laboratory to pilot to industrial scale will be discussed. Furthermore, students will be shown possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, smart sensors, machine learning, etc.).

Teaching content
Idea development, proof of concept, scaling / scalability, process design, hygienic design, process equipment (materials according to LM safety standards), metrology, plant design; Patents and Intellectual Property Lab course:

e.g. extrusion / encapsulation using the example of "beet".
Recommended previous knowledge
Basics of product development, food production; technical know-how.

Courses		
Teacher	**Titel of courses**	**Hours**
Professur „Food Technology and Digitalization“ / Dr. Kemal Aganovic (DIL)	Process Design - Lecture	14
Professur „Food Technology and Digitalization“ / Dr. Kemal Aganovic (DIL)	Plant Design – Lecture	14
Professur „Food Technology and Digitalization“ / Dr. Kemal Aganovic (DIL)	Process and Plant Design – Practical course	20
Professur „Food Technology and Digitalization“ / Dr. Kemal Aganovic (DIL)	Upscaling - Lecture	14

7.1.8 Microbial Ecology (DIL)

Microbial Ecology (Module 8)					
Semester / place	**Frequency of the module**	**Dauer**	**Type**	**ECTS points**	**Student work load**
2, DIL	1x each year (each summer semester)	Lecture whole semester (2h per week)	Compulsory module	6	180h: 42h Attendance study, 138h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points (type / duration of examination)**	**Teaching and learning methods**	**Modul-verantwortliche(r)**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme FPPE, Veterinärmedizin oder Animal Biology and Biomedical Sciences an der TiHo	Use of the module in the MSc FPPE programme enrolment in the courses for students oft he TiHo possible	Written exam	Lecture	Professur „Microbial Ecology“ / Dr. Kashif ur Rehmann (DIL)

Qualification goals
This module provides the basic knowledge of material cycles and involved microorganisms, microbial diversity in different food ecosystems, microbial interactions and special metabolic performances of microorganisms and their effects on ecosystems. Other objectives are to provide knowledge of modern microbiological methods for addressing ecological issues and the impact of food technology processes on microbial ecology. Furthermore, students will be shown possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, smart sensors, machine learning, etc.).

Teaching content
Role of microorganisms in the material cycle; Microbial growth; Microbial habitats; Interaction of microorganisms with their environment; Microbial interaction (commensalism, cooperation, mutualism, syntrophy); Anaerobic food webs; Language of bacteria (quorum sensing); Microorganisms in food; Microbial degradation of organic matter - spoilage; Influence of food technologies on microbial ecology; Modern taxonomy of microorganisms; Methods of microbial ecology.

Recommended previous knowledge
Basic knowledge of ecosystems, microbiology, etc.

Courses		
Teacher	**Titel of courses**	**Hours**
Professur „Microbial Ecology“ / Dr. Christian Hertel (DIL)	Microbial ecology of food – Lecture	14
Professur „Microbial Ecology“ / Dr. Christian Hertel (DIL)	Microbiota and Hygiene – Lecture	14
Professur „Microbial Ecology“ / Dr. Christian Hertel (DIL)	Microbial Diagnostics and food spoilage - Lecture	14

7.1.9 Information skills, general research skills (TiHo)

Information skills, general research skills (Module 9)					
Semester / place	**Frequency of the module**	**Duration**	**Type**	**ECTS points**	**Student work load**
1, TiHo	1x per year (each winter semester)	Seminar 8h in 1. week, 4h per week in the 2./3. week, 2h per week in the 4.-9. week, Seminar and colloquium 10.-14. week 3h per week	Compulsory module	5	150: 48h Attendance study, 102h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** (type / duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme FPPE, Veterinaey medicine or Animal Biology and Biomedical Sciences at TiHo	Use of the module in the MSc FPPE programme, enrolment in the courses for students oft he TiHo possible	presentation and evaluation of a current scientific publication comprehensive scientific literature research on a specific topic and oral presentation of the results (relevant for final mark), weighting 50/50 for the final mark	Seminar and Kolloquium	Prof. Sabine Leonhard-Marek (TiHo).

Qualification goals
Learning how and where to search for which format of scientific information and how to access and assess scientific Typeicles. Knowing the principles of good scientific practices, the possibilities of bias, and how to avoid plagiarism. Knowing relevant aspects of copyright law, forms of licences, open access publication and

academic identity management. Learning how to present information.

Teaching content
• Scientific research and information cycle, research data, metadata • Searching for evidence • Effective search queries (synonyms, Boolean operators, truncation, phrases, wildcards, proximity, PICO scheme) • Effective search strategies (thesauri, filters, ranking, related/similar records, citation networks, open knowledge graphs) • Databases and scientific search engines (specific content, special features / PubMed, CAB abstracts, Web of Science, Dimensions, Lens, study registers, BASE, …) • Publication formats and versions • Accessing information (electronic tools, services) • Assessing information, detecting and avoiding forms of bias (study design, controls, randomization, blinding, placebo/nocebo, time effects, meta-analyses, systematic reviews, references, completeness) • Presenting information (specific to target groups, motivation, key message, visualization) • Good scientific practice • Avoiding plagiarism (definitions, workflows, self-control), citing correctly (citation styles, literature management tools) • German Urheberrecht (relevant aspects of copyright law) • Licences, usage rights, CC licences, open materials, Open Access publications • Academic Identity Management
Recommended previous knowledge

Courses		
Teacher	**Titel of courses**	**SWS**
Prof. Sabine Leonhard-Marek (TiHo) oder N.N.	Information skills, searching for evidence - seminar	In total. 12 hours (1.-3. Week)
Prof. Sabine Leonhard-Marek (TiHo) oder N.N.	Good scientific praxis, avoiding plagiarism - seminar	In total 12 hours (2.-9. week)
Prof. Sabine Leonhard-Marek (TiHo) oder N.N.	Discussing and presenting scientific information – seminar and colloquium	In total 21 hours (5.-14. Week)

7.1.10 Food Biotechnology (DIL)

Food Biotechnology (Module 10)					
Semester / place	**Frequency of the module**	**Duration**	**Type**	**ECTS points**	**Student work load**
3, DIL	1x per semester	Lecture whole semester (1h per week), practical course 1 block week à 5h	Compulsory elective module	6	180h: 60h Attendance study, 120h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** (type / duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme FPPE, Veterinary medicine or Animal Biology and Biomedical Sciences at TiHo	Use of the module in the MSc FPPE programme, enrolment in the courses for students oft he TiHo possible	Written exam und Practical coursesreport (relevant for final mark), weighting 50/50 for the final mark	Lecture und Practical course	Professur „Nutritional Biochemistry“ / Dr. Christian Hertel (DIL)

Qualification goals
This module teaches the basic uses of biotechnological processes in food production to achieve desired changes in raw materials, (intermediate) products and side streams. This includes the use of cultures and enzymes to produce foods with specific organoleptic properties, high (microbiological) safety and high nu-tritional content. In addition, cultures and enzymes are looked at in terms of their potential for side stream utilization. Comparable processes can be applied in the utilization of waste products. Furthermore, students will be shown possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, smart sensors, machine learning, etc.)

Teaching content
Fermentation, enzymes and their uses, microbial cultures and their uses, side streams in the food system and their uses, food biochemistry, nutritional physiology and metabolism of humans, microbiome, next gen-eration sequencing (NGS) and bioinformatics, omics technologies, molecular biology methods for identifica-tion of

microorganisms in food.
Recommended previous knowledge
Basic (micro)biological knowledge (theoretical and practical), microbiological analysis methods, etc.

Courses		
Teacher	**Titel of courses**	**Hours**
Professur „Nutritional Biochemistry“ / Dr. Christian Hertel (DIL)	Food biochemistry and nutrition physiology - Lecture	4
Professur „Nutritional Biochemistry“ / Dr. Christian Hertel (DIL)	Food bioengineering – Lecture	8
Professur „Nutritional Biochemistry“ / Dr. Christian Hertel (DIL)	Applied molecular biology – Lecture	8
Professur „Nutritional Biochemistry“ / Dr. Christian Hertel (DIL)	Food biotechnology - Practical course	40

7.2 Compulsory elective modules: You need 5 out of 8

7.2.1 Business Innovation and Entrepreneurship in Food Technology (DIL)

Business Innovation and Entrepreneurship in Food Technology (Module E1)					
Semester / place	**Frequency of the module**	**Duration**	**Type**	**ECTS points**	**Student work load**
2 or 3. DIL	1x per semester	Lecture whole semester (1-2h per week), parallel tutorial (2h per week); last 2h tutorial at the end of the semester (preparation pitch decks + business plan)	Compulsory elective module	3	90h: 30h Attendance study, 60h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** (type / duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme	Use of the module in the MSc FPPE programme Studiengang FPPE	Pitch deck presentation incl. Q&A, written preparation of a business plan (5-10 pages in length). Weighting 50/50 for the final mark	Lecture und Tutorial	Dr. Prateek Mahalwar (BIOWEG) / Alexander Märdian (DIL)

Qualification goals
The module promotes the students' ability to think and act entrepreneurially. After completing the module, the participants are able to develop innovative business ideas. They know relevant methods and instruments for the development of new products and services and can apply them. They are able to interpret results from market and customer research and draw conclusions for a concrete business idea. The students acquire knowledge and skills for the foundation of their own company as well as basic knowledge in the development of business plans.

In the tutoring, what has been learned is deepened and applied in a practical way. Here, students have the opportunity to concretize their own innovative ideas within the framework of a business model or to work on case studies.

Furthermore, the students will be shown possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, intelligent sensors, machine learning, etc.).Furthermore, students will be shown the possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, intelligent sensors, machine learning, etc.).

Teaching content
Lecture (and accompanying tutoring) 1) Fundamentals in Management Strategy and Economics (2h) 2) Entrepreneurial & Intrapreneurial Spirit and User centric Innovation Methods & Business Creation (2h) 3) Business Modelling (Canvas) and Development & Testing of Business Ideas (2h) 4) Market Analysis and International Marketing, Sales & Management (2h) 5) Drafting of Business Presentations and Business Plans (2h) 6) Basics of Financial Planning (2h) 7) Basics of Company Formation (1h) 8) Fundraising (1h)
Recommended previous knowledge
-

Courses		
Teacher	**Titel of courses**	**Hours**
Dr. Prateek Mahalwar (Fa. BIOWEG)	Entrepreneurship and Innovation – Lecture	20
Alexander Märdian (DIL)	Business Case Modelling - Tutorial	10

7.2.2 Digitalization in food processing (DIL)

Digitalization in food processing (Module E2)					
Semester / place	**Frequency of the module**	**Dauer**	**Type**	**ECTS points**	**Student work load**
2 or 3, DIL	1x per semester	Lecture whole semester (2h per week)	Compulsory elective module	3	90h: 28h Attendance study, 62h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** (type / duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme	Use of the module in the MSc FPPE programme	Written exam	Lecture	Professur „Food Technology and Digitalization“ , Dr. Volker Lammers / Dr. Kemal Aganovic (DIL)

Qualification goals
After completing the module, students will be able to identify digitization potential in business models. They also understand the requirements for IT systems that are related to the digitization of processes. They have gained detailed insights into possibilities for automating and simulating processes and steps in the food sector. They are familiar with data protection regulations and ethics in the course of digitalization. They un-derstand how the digital transformation is to be implemented in business practice..

Teaching content
Automation and simulation techniques in the food process, fundamentals of digitalization, Big Data, Industry 4.0 matrix in the food process, Internet of Things and Services, design thinking, horizontal integration, spe-cialized data model, software system environment, assistance systems, augmented reality and virtual reality, IT security and data protection, ongoing and digital engineering, digital ethics, algorithmization of behavior, opinions and identities, trends for the design of production 4. 0 (digital assistance systems, forms of inter-action in work situations, etc.), principles and benefits of data collection, data management and data analy-sis in food processing and development, ERP, software in the area of control, execution and manufacturing, machine learning in food processing.
Recommended previous knowledge

Basic knowledge of food production and technology, basic math skills, etc.

Courses		
Teacher	**Titel of courses**	**Hours**
Professur „Food Technology and Digitalization“	Automatization and simulation - Lecture	7
Professur „Food Technology and Digitalization“	Industry 4.0 in Food Processing – Lecture	7
Professur „Food Technology and Digitalization“	Ethics – Lecture	7
Professur „Food Technology and Digitalization“	Data protection – Lecture	7

7.2.3 Food Quality and Food Safety (Food Poisoning) (TiHo)

Food Quality and Food Safety (Food Poisoning) (Module E3)					
Semester / place	**Frequency of the module**	**Duration**	**Type**	**ECTS-points**	**Student workload**
1, 2 or 3, TiHo	1x per semester	Oral lecture whole semester (2h per week)	Compulsory elective module	3	90h in total 28h in presence 62h self study

Requirements for pTypeicipation	**Usability**	**Prerequisite for the award of credit points (type / duration of examination)**	**Teaching and learning methods**	**Responsible person for the module**
Bachelor of Science or Bachelor of Engineering , Admission to the FPPE, Veterinary Medicine or Animal Biology and Biomedical Sciences program at TiHo	Use of the module in the FPPE program, occupancy can be taken by TiHo Students (Veterinary Medicine, Animal Biology, Biomedical Sciences)	Oral lectures as a result assurance of practical approach or literatury study (results from project thesis) (relevant to final mark 50/50)	Lecture, excursion of applicaple, Tutorial, supervised project thesis (incl. self study)	Prof. Madeleine Plötz (TiHo)

Qualification goals
Students acquire knowledge of toxicokinetics and toxicodynamics and can evaluate scientifically the behavior and mode of action of toxic substances in the human organism. They deepen and further develop this knowledge using specific substances as examples and can highlight their significance for humans. They can describe and critically discuss the properties and significance of specific substances for humans on the basis of selected examples and reflect on their significance for nutrition and food practice. They use acquired knowledge to place toxicological knowledge in a superordinate professional context in relation to the practice of food development and production as well as nutrition. Students have in-depth knowledge of food safety and quality management and have a basic understanding of food hygiene issues. They will be able to describe and evaluate quality assurance measures. In addition, the students get a basic overview of drugs and contaminants in relation to effect and behavior in the organism. Furthermore, the students learned possibilities for the integration of digital technologies (for example IoT, blockchain, cloud-computing, intelligent sensors, and machine learning) into these processes.

Teaching contents

- Importance of physical, chemical and biological contaminants for food production and human nutrition. - Food toxicology (mechanisms of action, kinetics and dynamics of contaminants, toxicological parameters, hazard and risk) - Hazards at the different stages of production - Detection methods (lateral flow, biological detection systems, PCR, ELISA, GC, LC-MS) - Decontamination methods (physical, chemical, biological)
Recommended previous knowledge

Courses		
Responsible person	**Title of the lecture/ seminar/ course**	**Hours in total**
Plötz	Residues and Contaminants „From Farm to Fork“	2
Plötz and others	Food toxicology – Hazard assessment	2
Plötz	Hazards: primary production to consumer household	4
Plötz and others	Selected (analytical) detection methods	4
Plötz and others	Decontamination methods (old and new -> perspectives)	4
Plötz	Project thesis (scientific topic): specifications, selection, guidance and monitoring (tutorial)	4
Plötz	Scientifiv presentations of the project topics (examination)	6
Plötz	Final results results: feedback, reflection and exchange of experiences	2

7.2.4 Process Economy (DIL)

Process Economy (Module E4)					
Semester / place	**Frequency of the module**	**Dauer**	**Type**	**ECTS points**	**Student work load**
2 or 3, DIL	1x per semester	Lecture whole semester (1h per week), Tutorial 4x4h	Compulsory elective module	3	90h, davon 30h Attendance study, 60h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** ((type / duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme	Use of the module in the MSc FPPE programme Studiengang FPPE	Written exam und Case Study Report/Präsentation (relevant for final mark), Weighting 50/50 for the final mark	Lecture und Tutorial	Professur „Food System Analysis“ / Dr. Volker Heinz (DIL)

Qualification goals
In the sense of a system-based approach, students should acquire the necessary competencies to develop solution approaches for current challenges and to initiate change processes. In addition to classical systems knowledge, transformation knowledge is required, which focuses on change processes caused by interac-tions with other systems. Students will develop an understanding of changing food systems so that they can grasp the complexity resulting from interactions with other systems in an operational environment and, based on this, develop forecasts and technologies for sustainable food production. Furthermore, students will be exposed to opportunities for integrating digital technologies (e.g. IoT, block-chain, cloud computing, smart sensors, machine learning, etc.).

Teaching content
Basics of the food chain, food system analysis, saving avoidable process costs, obtaining fast and cost-saving results, consideration of the individual process, but also of the totality of processes, system-based approach to food production.
Recommended previous knowledge

Basic knowledge of process development, business economics, etc.

Courses		
Teacher	**Titel of courses**	**SWS**
Professur „Food System Analysis“ / Dr. Volker Heinz (DIL)	Food system analysis and food chain - Lecture	7
Professur „Food System Analysis“ / Dr. Volker Heinz (DIL)	Process economy – Lecture	7
Professur „Food System Analysis“ / Dr. Volker Heinz (DIL)	Case study - Tutorial	16

7.2.5 Consumer Science (DIL)

Consumer science (Module E5)					
Semester / place	**Frequency of the module**	**Dauer**	**Type**	**ECTS points**	**Student work load**
1, 2 or 3	1x per semester	Oral lecture whole semester (2 h per week)	Compulsory elective module	3	90 h in total 28 h in presence 62 h self study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** ((type / duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science or Bachelor of Engineering, Admission to the FPPE, Veterinary Medicine or Animal Biology and Biomedical Sciences program at TiHo, PTypeicipation in the module 9 Scientific Writing and Literature Research	Use of the module in the FPPE program, occupancy can be taken by TiHo students (Veterinary Medicine, Animal Biology, Biomedical Sciences)	Oral lecture as a result assurance of practical approach or literature study (results from project thesis) (relevant to final mark 50/50)	Lecture, tutorial, supervised project thesis (incl. self study)	Dr. Adriano Profeta (DIL) Dr. Clara Mehlhose (DIL)

Qualification goals
• Knowledge enhancement Students are familiar with the basic methods of market psychological research and gain an insight into the most important practical field of application, psychological market research, and its topics and issues. • Deepening of knowledge The students understand the necessity of business success prognoses and the important and purposeful role of market psychological investigations, which serve the goal of the predictability of the market success. • Ability - instrumental competence Students will acquire the ability to apply the acquired knowledge of market psychology on the background of business management issues. Furthermore, students will be shown possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, smart sensors, machine learning, etc.).

Teaching contents

Classification of market and consumer research in business contexts:

- Market psychology as an empirical science,
- Social role distribution in the market (suppliers, consumers, functionaries),
- Clients of market psychological research as well as investigated target groups and industries,
- Relationship between marketing and market research (market research as a means of supporting business forecasts of success),
- Market psychology for the evaluation of sales policy instruments (product design, pricing policy, advertising, sales),
- Difference between sales research and psychological market research,
- Empirical market research along the product life cycle,
- Typical procedure of a market research project

Furthermore, basic methods of empirical social research are discussed, which are applied in market psychology, namely the interview (survey media; qualitative & quantitative interview techniques), behavioral observation, as well as various procedures for obtaining samples.

Specific market research tools are presented in their respective thematic context, e.g.:

- Target group description and segmentation,
- Testing of product concepts (e.g. conjoint analysis),
- Measurement of price acceptance,
- analysis of brand images,
- Testing of advertising media (advertising pretest, advertising mail test),
- customer satisfaction measurement

Recommended previous knowledge
Basic knowledge in marketing and market research, etc.

Courses		
Responsible Person	**Responsible Person**	**Hours in total**
Dr. Adriano Profeta (DIL)	Introduction into consumer behaviour	4
Dr. Adriano Profeta (DIL)	Consumer Analytics in R (open statistical software)	2
Dr. Adriano Profeta (DIL)	Special consumer research methods (Discrete Choice Experiments, Online Surveys, Eyetracking)	2
Dr. Clara Mehlhose (DIL)	Sensorial tests with untrained consumers	8
Dr. Adriano Profeta (DIL)	The project thesis: specifications, selection, guidance and monitoring (tutorial)	2

Dr. Adriano Profeta (DIL)	Presentations of the project thesis (examination)	8
Dr. Adriano Profeta (DIL)	Securing results: feedback, reflection and exchange of experiences	2

7.2.6 Lean Management (DIL)

Lean Management (Module E6)					
Semester / place	**Frequency of the module**	**Dauer**	**Type**	**ECTS points**	**Student work load**
2 or 3, DIL	1x per semester	Block course (5 days): Lecture 4h daily, tutorial (2h per day)	Compulsory elective module	3	90h: 30h Attendance study, 60h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** (type / duration of examination)	**Teaching and learning methods**	**Modul-verantwortliche(r)**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme	Use of the module in the FPPE program	Processing and presentation of the exercise task in the area of Lean Management	Lecture and tutorial	Frank Krause (STAUFEN AG)

Qualification goals
Students should acquire the necessary basic knowledge on the subject of lean management for the design of low-waste and lean processes in the food industry. This will enable students to apply the basic knowledge directly to the subsequent development of products. The basic principles of the continuous im-provement process (CIP) are to be taught in order to enable the students to independently carry out CIP projects. After completing the module, students should be able to design processes more sustainably and recognize potential for increasing productivity. They will be able to use resources in production in a targeted manner and avoid waste. In group work/exercises, the acquired knowledge is to be transferred in a practice-oriented manner. Further-more, company visits will provide the opportunity to apply lean management in a real company. In addition to the acquired knowledge, soft skills such as communication and presentation techniques as well as teamwork should be promoted. Furthermore, students will be shown the possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, intelligent sensors, machine learning, etc.).

Teaching content

Four principles of lean management:

- Freedom from disruption (process stability): maintain tools, transfer analogy from automotive industry to food industry, structured problem solving
- Flow: Determining meaningful sequences and repetitions.
- Rhythm: factory function, duration of processes, derivation of a cycle
- Suction: pulling production, logistics

Based on these four principles, the methodology of Lean Management is taught. These are applied by the students in subsequent tutorials/exercises in order to develop structured solutions to practical problems. The scenarios include different industries, companies and countries.

Further possible teaching content:

- Creation of a value stream analysis (possibly "from farm to fork")
- Overall Equipment Efficiency (OEE)
- Methods for 0-defect quality (via worksheets)
- Process economics: Arrangement of equipment to achieve the lowest scrap rate
- Scale-up
- Backward planning in the production process
- Definition of key figures for different process steps to monitor lean management

Recommended previous knowledge

Courses		
Teacher	**Titel of courses**	**Hours**
Frank Krause (STAUFEN AG)	Lean Management - Lecture	20
Frank Krause (STAUFEN AG)	Application Lean Management – Tutorial	10

7.2.7 Food Sensomic (TiHo)

Food Sensomic (Module E7)					
Semester / place	**Frequency of the module**	**Duration**	**Type**	**ECTS-points**	**Student workload**
2 or 3, TiHo	1x per semester	Oral lecture whole semester (2 h per week)	Compulsory elective module	3	90 h in total 28 h in presence 62 h self study

Requirements for pTypeicipation	**Usability**	**Prerequisite for the award of credit points (type / duration of examination)**	**Teaching and learning methods**	**Responsible person for the module**
Bachelor of Science or Bachelor of Engineering, Admission to the FPPE, Veterinary Medicine or Animal Biology and Biomedical Sciences program at TiHo, PTypeicipation in the module 9 Scientific Writing and Literature Research	Use of the module in the FPPE program, occupancy can be taken by TiHo students (Veterinary Medicine, Animal Biology, Biomedical Sciences)	Oral lecture as a result assurance of practical approach or literature study (results from project thesis) (relevant to final mark 50/50)	Lecture, tutorial, supervised project thesis (incl. self study)	Dr. Lisa Siekmann (TiHo)

Qualification goals
Students will gain insight into the importance and applications of sensory testing. They will learn the basics of sensory testing methods and will be enabled to select test persons in a sensible and targeted manner oriented towards an individual test object. Also, they will elaborate a project thesis as a core element of this module by using the knowledge from Module 9 (Scientific Writing and Literature Research). Thus, they will either develop an overview of current findings on a sensory method (literature study) or carry out a practical sensory test on their own within the module (practical approach). The practically oriented pType is flanked by knowledge as well as demonstrations and application of analytical methods (e.g. texture measurement, head space, instrumental measurement of visual, olfactory and gustatory parameters). This opens the awareness for strengths and weaknesses of human and instrumental perception and their respective combination as well as a foundation for a purposeful and conscious application. This paves the way for both assessment and consulting activities for future graduates in quality assurance, product development, and other industries. The independent choice of the project work topic offers the freedom for individual consolidating studies and further education in the personal focus of interest

Teaching contents
- Scope of application of sensory examination methods - Classic and modern sensory testing methods - Selection of suitable test persons, establishment of a sensory panel - Human sensory physiology and sensory active natural substances - Sensometabolome of food, identification and quantification of key odorants - Sensomic in connection with dietetics, structure-activitiy relationships - Molecular sensory analysis and acquisition of sensory parameters by technical instruments (e.g. GC/MS, GC-O, AEDA, HPLC, TDA a. o.) - Aroma analysis- odor perception and key odorants and their relevance for the production or (new) development of foodstuffs - Latest findings on rapid sensory methods and combinations with instrumental analytics - Planning and implementation of own sensory questions (within the project thesis) - Exchange of experience and feedback on the project thesis within the module (selection of topics according to the students' main interests)
Recommended previous knowledge
Module 9 Scientific Writing and Literature Research; independent development and elaboration of own questions, as well as evaluation and discussion; forms of digital presentation of results

Lecture/ seminar /course		
Responsible Person	**Title of the lecture/ seminar/ course**	**Hours in total**
Dr. Lisa Siekmann	Sensory testing methods: Areas of application, framework conditions, opportunities and limitations	2
Dr. Lisa Siekmann	Sensory analysis testers: selection, proficiency testing, qualification and establishment of a sensory panel	2
Dr. Lisa Siekmann	Sensomics: human sensory physiology, sensory active substances and key odorants	2
Dr. Lisa Siekmann and others	Sensory physiology and aroma analysis: Implications for food technology and development (key odorants, development of new products, dietetical aspects); Instrumental analytics: Possibilities, fields of application, limits and potential	8
Dr. Lisa Siekmann and others	The project thesis: specifications, selection, guidance and monitoring (tutorial)	6
Dr. Lisa Siekmann and others	Presentations of the project thesis (examination)	8
Dr. Lisa Siekmann	Securing results: feedback, reflection and exchange of experiences	2

7.2.8 Quality Management in Food Production / Public Health (TiHo)

Quality Management in Food Production / Public Health (Module E8)					
Semester / place	**Frequency of the module**	**Duration**	**Type**	**ECTS-points**	**Student workload**
1, 2 or 3, TiHo	1x per semester	Whole semester (2 h per week)	Compulsory elective module	3	90 h In total 28 h In presence 62 h Self study

Requirements for pTypeicipation	**Usability**	**Prerequisite for the award of credit points (form of examination/ Duration of examination)**	**Teaching and learning methods**	**Responsible person for the module**
Bachelor of Science or Bachelor of Engineering, Admission to the FPPE, Veterinary Medicine or Animal Biology and Biomedical Sciences program at TiHo.	Use of the module in the FPPE program, occupancy can be taken by TiHo students (Veterinary Medicine, Animal Biology. Biomedical Sciences)	Oral examination (30 min), homework, percentage of the home work on the final mark 30 %	Lecture, Home work	PD Dr. Carsten Krischek (TiHo)

Qualification goals
Quality management Systematic quality management makes operational processes transparent and serves to ensure quality standards. In this module, students learn the basic elements and common methods of modern QM systems as well as important standards and (audit) requirements. They know how to permanently ensure the targeted or legally required quality standards at process and product level. Furthermore, the students are able to analyze hazards and create a HACCP concept based on a risk assessment. Public Health The aim of food safety is to ensure that food is safe for human health and thus to protect the public from consumer-relevant risks. The students learn which risks can occur along the food production chain (e.g. from the original animal production to transport and slaughter to the processing and finishing of meat products) and which process stage-oriented precautions and measures enable the avoidance or reduction of quality-reducing

influences on food. Furthermore, students will be shown possibilities of integrating digital technologies (e.g. IoT, blockchain, cloud computing, smart sensors, machine learning, etc.).

Teaching contents
Quality management - Documentation of a quality management system - Implementation of internal audits - HACCP concept - Complaint management - crisis management - supplier evaluation - traceability - Allergen management - Overview of legal framework on international and national level - European and German food control systems - Basic regulation of food hygiene for food business operators - Definitions according to DIN ISO 9000 series of standards - Total Quality Management - Regulations for GMOs - EC Organic Regulation Public Health Presentation and evaluation of physical, chemical and biological risks of foodstuffs of of animal and plant origin, including feed safety; naming and validity of relevant legislation; nature and tools of risk management; exemplary preventive measures to avert risks
Recommended previous knowledge

Lecture/ seminar /course		
Responsible Person	**Title of the lecture/ seminar/ course**	**Hours in total**
Krischek (TiHo)	Quality management systems in food production	12
Krischek (TiHo)	Introduction into national and supranational food regulations /with focus on EU and Germany), involved organizations	4
Krischek (TiHo)	Combating misdemeanors and criminal offenses in food law	6
Krischek (TiHo)	Specific legislation for specific foods and its application (EU	4

	marketing regulations, Novel Food Health Claim)	
Krischek (TiHo)	Discussion of the home works	2

7.3 Module Intensive Case Study and Master thesis (TiHo, DIL)

Intensive Case Study (TiHo, DIL)					
Semester / place	**Frequency of the module**	**Dauer**	**Type**	**ECTS points**	**Student work load**
3	Flexible	One semester	Compulsory module	18	540h: 204h Attendance study, 336h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** ((type / duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme	Use of the module in the MSc FPPE programme Studiengang FPPE	Preparation of exposé/presentation, intensive case study and oral examination (colloquium), weighting: 20/40/30	Mentoring by mentors and lecturers, colloquium	NN

Qualification goals
This module is carried out in the 3rd semester, a research and development work is to be done. This may involve a new topic or be related to an existing research project. The Intensive Case Study must be assigned to a module and is supervised by the person responsible for the module. This work is always to be done in cooperation with cooperating companies, member companies of the DIL, project partners, the TiHo or at the DIL itself. The Intensive Case Study can also be carried out at partner universities abroad. Alternatively, it is also possible to prepare a literature paper on the state of the art of a certain technology or development as an Intensive Case Study. In this case, a high-quality review on a defined topic should be prepared at the end, which should also be published if possible. It should be considered whether a poster and a presenta-tion on the defined topic should also be prepared. It is possible to work on the Intensive Case Study together with the Master Thesis if it is a more intensive research and development project. Likewise, two smaller research and development projects can also be worked on in the Intensive Case Study if these alone do not fill the workload. Before carrying out the Intensive Case Study, students should prepare an exposé, which will be reviewed by the supervisors.

Teaching content
The students independently research literature for their Intensive Case Study and are supervised by their

respective mentor. The knowledge acquired in Module 7 will be incorporated here. They prepare an ex-posé or a presentation on the basis of which the project for the Intensive Case Study is presented in advance and coordinated with the mentor/lecturer. For any experimental projects, experiments are to be applied using the previously acquired knowledge from the various internships. Students should learn to apply their previously acquired knowledge to a paper. This also serves as a better preparation for the upcoming master thesis, so that a successful completion is guaranteed. Through the subsequent colloquium after submission of the Intensive Case Study, students learn to critically reflect on their work and results and to recognize potential for improvement.

Courses		
Teacher	**Titel of courses**	**Hours**
NN	Literature research / Writing	2
NN	Practical course or review writing	240
NN	Colloquium	2

Master thesis (TiHo, DIL)					
Semester / place	**Frequency of the module**	**Duration**	**Type**	**ECTS points**	**Student work load**
4, TiHo, DIL	flexible	One semester	Compulsory module	30	900h: 349h Attendance study, 551h Self-study

Requirements for participation	**Usability**	**Prerequisite for the award of credit points** ((type / duration of examination)	**Teaching and learning methods**	**Module representative**
Bachelor of Science oder Bachelor of Engineering in Food Technology o.Ä., Admission to the programme	Use of the module in the MSc FPPE programme	Preparation of exposé/presentation, Master's thesis and oral examination (colloquium), weighting: 20/40/30	Mentoring by mentors and lecturers, colloquium	NN

Qualification goals

The aim of the Master's Thesis is for students to work on a research question within a given period of time using scientific methods that they have already learned in semesters 1 and 2. Thus, in the Master Thesis, a scientific topic is to be worked out independently.
It is possible to include the work of the Intensive Case Study from the 3rd semester in the Master Thesis, provided that the research question of the Intensive Case Study is clearly included in the topic of the Master Thesis. The master thesis is always to be written in cooperation with cooperating companies, member companies of the DIL, project partners, the TiHo or at the DIL itself. The master thesis can also be carried out at partner universities abroad. This promotes international cooperation as well as the students' language skills. With the completion of this thesis, students thus receive proof that they are able to write a scientific paper independently, but under supervision. The experiments are to be designed in a goal-oriented manner and to develop a current/innovative research topic so that the results of the master's thesis can be included in a publication.

Teaching contents

The students independently research literature for their master's thesis. They prepare an exposé or a presentation on the basis of which the master thesis project is presented in advance and coordinated with the mentor/lecturer. Here, the students benefit from the knowledge previously acquired in the modules. The master thesis is carried out practically. Planning, execution and evaluation of the experiments are carried out independently. Here the students use their experiences from the preceding Intensive Case Study in the 3rd semester. In the subsequent colloquium after submitting the master's thesis, students learn to critically reflect on their work and results and to recognize potential for improvement.

Courses		
Teacher	**Titel of courses**	**Hours**
NN	Literature research / Writing	3
NN	Practical course or review writing	343
NN	Colloquium	3