University of Debrecen Faculty of Agricultural and Food Sciences and Environmental Management

Food Safety and Quality MSc Program

2023

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**DEAN’S WELCOME**

On January 1, 2000, the University of Debrecen was born with the need for international competitiveness, which is now the oldest continuously operating higher education institution in the country. It is one of the excellent universities in Hungary, with its 14 faculties and 24 doctoral schools, offering the widest domestic training. Today, the University of Debrecen carries out its agricultural training, research and development activities in three organizational units: the Faculty of Agriculture, Food Science and Environmental Management (MÉK), the Faculty of Economics (GTK) and the Institutes for Agricultural Research and Educational Farm (AKIT). The Faculty of Agriculture, Food Science and Environmental Management - adapting to today's scientific challenges - formulates both its training and research activities according to the circular bioeconomy model, which is based on the recycling of materials and values, by increasing the added value of the produced product, through services and smart solutions. In the ranking of agricultural and higher education institutions in the world, Debrecen is always in the most prominent place, currently it is among the best between 150-200.

The Faculty of Agriculture, Food Science and Environmental Management of the University of Debrecen currently has nearly 1,400 students, and in addition to our Hungarian-language courses, more and more foreign students attend our courses taught in English. Our undergraduate and master's programs, our talent management colleges, and our doctoral schools all play a decisive role in higher agricultural education and scientific supply. It is especially important for us to maintain a wide-ranging system of professional and economic relations with the enterprises of the region, which, on the one hand, provides the conditions for practical training and, on the other hand, helps to utilize the scientific results created at the University. Following the good example of our predecessors, we try to provide students with up-to-date knowledge and practice-oriented knowledge, so that they can enhance and improve the reputation of our institution and Hungarian agriculture.

Dr. László Stündl

associate professor

dean

**HISTORY OF THE UNIVERSITY**

The University of Debrecen, the oldest institution of higher education in the country operated continuously in the same city, is one of the research universities of national excellence in Hungary offering the widest spectrum of educational programs in 14 faculties and 24 doctoral schools.

The roots of higher education in the city reach all the way back to the 16th century and the foundation of the Reformed College of Debrecen in 1538. The College played a central role in Hungarian education and culture for centuries. This is the date featured on the symbol of the university as well, the *gerundium,* a tool originally used by the students of the Reformed College to put out fires, showing respect for ancestors and traditions.

In 1912 with Act XXXVI, originally submitted as a bill by Count János Zichy, Minister of Religion and Public Education, the Hungarian Parliament decided on the establishment of two universities, one in Pozsony [Bratislava] and the other in Debrecen. Thus the Hungarian Royal University of Debrecen was established in the *cívis* town with five faculties (Faculty of Reformed Theology, Faculty of Law, Faculty of Medicine, Faculty of Arts, Linguistics and History, and the Faculty of Mathematics and Science). However, the university opened only two years later, in 1914 with three faculties. First, students studied in the building of the Reformed College, which soon proved to be too small. The city of Debrecen granted a huge (112 acre) land in the Great Forest for the university, and also provided first 5 then an additional 3 million Golden Koronas for the construction of a new building. In 1918 Charles IV inaugurated the central building of the newly founded Faculty of Medicine. The teaching of mathematics and natural sciences started within the Faculty of Arts from the 1923/24 academic year. The independent Faculty of Sciences was opened only in 1949.

In 1921 the university was named after Count István Tisza, former prime minister and statesman who also studied in the Reformed College and who was assassinated on October 31, 1918. Thus the name of the institution was changed to István Tisza Hungarian Royal University of Debrecen.

The construction of the main building of the university started in the 1920s and it was officially opened in 1932. At the time it was the third largest investment project of the country after the building of the Parliament and the Buda Castel Palace. Construction lasted for four years, even so only one third of the original plans could be realized.

After the Second World War the fragmentation of the university (then already having five faculties) was started in 1949 due to political reasons. In the same year the Faculty of Law was temporarily suspended, in 1950 the Faculty of Theology was separated from the university, and it returned to the College with support from the church. Making medical training independent, the Medical University of Debrecen was organized in 1951. The university bore the name of István Tisza until 1945, then it was named University of Debrecen, then from 1952 it operated under the name of Lajos Kossuth University.

In the 1980s negotiations already started about the reunification of fragmented higher education in Debrecen. Events leading to integration, however, accelerated only after 1996 when an amendment stipulated that after December 31, 1998 universities had to provide educational programs of adequate quality in several disciplines.

Finally, on January 1, 2000 the University of Debrecen was established with the integration of the Agricultural University of Debrecen, the Medical University of Debrecen, Lajos Kossuth University, and the István Wargha Teacher Training College of Hajdúböszörmény. The university having an important role and position in Hungarian higher education started its operation with five university and three college faculties organized into three centers, the Center for Agricultural and Applied Economic Sciences, the Medical and Health Science Center, and the Center of Arts and Sciences.

Section 26 of Act CCIII of 2013 on the amendment of particular acts establishing the central budget of Hungary for 2014 included provisions concerning the organizational structure of the university, thus the centers were no longer used as organizational units as of January 1, 2014.

Today the University of Debrecen is a leading and prominent institution of higher education in Hungary. It is not only at the forefront of Hungarian and international education but also active in the fields of research, innovation and development, and enjoys fruitful links with the business sector. The ever-changing social and economic environment demands continuous renewal from the institution and there is a constant need to adapt to new requirements. The University of Debrecen’s mission is to contribute to the education of future generations in cooperation with Hungarian and international partners, with high-quality interdisciplinary programs, and research built on versatile and practical experience.

Besides education, the institution also provides European-quality patient care with comprehensive services to fulfil its obligations in the city, county, and region and often on the national level as well. As of July 1, 2017, with the merger of the Kenézy Gyula Hospital and Clinic, the University of Debrecen Kenézy Gyula Teaching Hospital was established, expanding the capacities of the institution both in patient care and education.

**HISTORY OF THE FACULTY**

The Great Plain and, more broadly, the Tisza River Basin is the center of Hungary's agri-food economy. That is why it was a logical decision from our predecessors to have a higher education and research center in the region to support the production and processing of raw materials, which helps to create and maintain a competitive agriculture by continuously providing qualified human resources and putting scientific results into practice.

In Eastern Hungary, agricultural higher education started in 1868 with the establishment of the Debrecen National Higher School of Economics. Between 1874 and 1906, the institution operated as the Secondary School of Economics, and until 1944 under the name of the Royal Hungarian Academy of Economics. Between 1945 and 1949, our institution operated under the name of the Debrecen Department of the Hungarian University of Agricultural Sciences, Faculty of Agricultural Sciences. In 1953, training resumed at the Debrecen Agricultural Academy. Between 1962 and 1970, specialist training rose to university level at the College of Agricultural Sciences. Between 1970 and 1999, the institution received the “university rank”, the University of Agricultural Sciences in Debrecen served two rural faculties (Szarvas, initially Hódmezővásárhely, later Mezőtúr).

On January 1, 2000, the University of Debrecen was established with five university faculties, three college faculties and three research institutes. The Faculty of Agricultural Economics and Rural Development was established in 2002 and by 2006 the number of faculties of the University had increased to 15. The Faculty of Agriculture, Food Science and Environmental Management (MÉK) and the Faculty of Economics and Rural Development (GVK), as well as three research institutes, formed the Center for Agricultural and Management Sciences (AGTC) until 2014.

# **ADMINISTRATION UNITS FOR INTERNATIONAL PROGRAMMES**

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The Coordinating Centre for International Education supports the international degree programmes of the University of Debrecen in giving new students information on admission and entrance exam. It has tasks in promoting and is in charge of tasks like enrolment, study contracts, modifying student status or degree programme, activating student status, modifying students’ personal data, requesting and updating student cards, providing certificates for the Immigration Office (for residence permit), issuing student status letters and certificates on credit recognition, concluding health insurance contract and providing Health Insurance Card, helping students with visa process application.

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The International Office has been functioning since 2014 in order to ensure the smooth running of the international degree courses. The office is responsible for student administration (full-time students, full-time transfer students, visiting/Erasmus students), providing certificates for students, considering and accepting requests, solving problems related to course registration, giving information about internship, final exam, thesis, etc.

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[**Institute of Animal Science, Biotechnology and Nature Conservation**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22240)

[Department of Animal Husbandry](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22245)

Agricultural Genomics and Biotechnology Center, Animal Genomics Research Team

Department of Animal Nutrition and Food Biotechnology

[Department of Nature Conservation, Zoology and Game Management](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22247)

[**Institute of Crop Sciences**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22210)

Department of Applied Plant Biology

Department of Crop Production, Applied Ecology and Plant Breeding

[**Institute of Food Science**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22209)

**Institute of Food Technology**

[**Institute of Horticulture**](http://www.agr.unideb.hu/etk/xsearch.php?lstDep=22250)

[**Institute for Land Use, Engineering and Precision**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22203) **Farming Technology**

Department of Agricultural Engineering and Robotics

Department of Land Use

Department of Precision Technology

**Institute of Nutrition**

[**Institute of Plant Protection**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22211)

[**Institute of Water and Environmental Management**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22214)

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# **INSTITUTE OF HORTICULTURE**

138, Böszörményi str., Debrecen H-4032, Tel: +36-52-508-444 / 88146

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# [**INSTITUTE FOR LAND USE, ENGINEERING AND PRECISION**](http://www.agr.unideb.hu/etk/xsearch.php?optLang=en&lstDep=22203) **FARMING TECHNOLOGY**

# **Department of Agricultural Engineering and Robotics**

# **Department of Land Use**

# **Department of Precision Technology**

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**INSTITUTE OF NUTRITION**

138, Böszörményi str., Debrecen H-4032, Tel: +36-52-508-444 / 88433

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# **INSTITUTE OF PLANT PROTECTION**

138, Böszörményi str, Debrecen H-4032, Tel: +36-52-508-444 / 88146

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| Dr Szilvia Kovács  Assistant Research Fellow | [kovacs.szilvia@agr.unideb.hu](mailto:kovacs.szilvia@agr.unideb.hu)  basement, building K-L |

**INSTITUTE OF WATER AND ENVIRONMENTAL MANAGEMENT**

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**ACADEMIC CALENDAR**

**University calendar of the academic year 2023/2024**

|  |  |
| --- | --- |
| **Academic year opening ceremony** | 3rd September 2023 (Sunday) |
| **1st semester study period:** | 4th September – 1st December 2023 (13 weeks) |
| 1st semester study period for **graduating** students: | 4th September – 3rd November 2023 (9 weeks) |
| **1st semester exam period:** | 11th December – 22nd December 2023 (2 weeks)  8th January 2024 – 9th February 2024 (5 weeks) |
| 1st semester exam period for **graduating** students: | 6th November – 24th November 2023 (3 weeks) |
| Thesis submission deadline | 25th October 2023 |
| Departmental thesis defence | 22nd – 23rd November 2023 |
| Final exam period | 4th – 6th December 2023 |
| **2nd semester study period:** | 19th February – 17th May 2024 (13 weeks) |
| 2nd semester study period for **graduating** students: | 19th February – 19th April 2024 (9 weeks) |
| **2nd semester exam period:** | 20th May – 5th July 2024 (7 weeks) |
| 2nd semester exam period for **graduating** students: | 22nd April – 24th May 2024 (5 weeks) |
| Thesis submission deadline | 26th April 2024 |
| Departmental thesis defence | 22nd – 23rd May 2024 |
| Final exam period | 10th – 12th June 2024 |

**ACADEMIC CALENDAR OF THE FACULTY OF AGRICULTURAL AND FOOD SCIENCES AND ENVIRONMENTAL MANAGEMENT**

The academic calendar for the given semester can be found on the faculty's website: https://www.edu.unideb.hu/tartalom/downloads/University\_Calendars\_2023\_24/University\_calendar\_2023-2024-Faculty\_of\_Agricultural.pdf

# **THE FOOD SAFETY AND QUALITY ENGINEERING GRADUATE PROGRAM**

INTRODUCTION OF THE PROGRAM

|  |  |
| --- | --- |
| Name of graduate program: | Food Safety and Quality Graduate Program |
| Level: | MSc |
| Qualification: | Food Safety and Quality Engineer |
| Mode of attendance: | Full-time |
| Faculty: | Faculty of Agricultural and Food Sciences and Environmental Management |
| Program coordinator: | Béla Kovács, professor |
| Program length: | 4 semesters |
| Credits total: | 120 credits |

The aim of the training is to train food safety and quality engineers who are committed to their profession in the field of food chain safety and quality and have the appropriate learning outcomes who - with the knowledge of microbiology, molecular biology, toxicology, analysis, health and food law - can effectively supervise and control the process of producing and marketing safe and high-quality food suitable for human consumption in all respects. They are prepared to continue their studies in doctoral training.

Disciplines leading to the qualification, fields of expertise from which the program is composed:

disciplines that create the interdisciplinary basic science of food safety and quality knowledge (nutrition science knowledge, toxicology of raw materials and food, microbiological knowledge, properties of food matrices, technological and microbiological aspects of food quality and safety) 15-20 credits;

modern testing methods guaranteeing food safety and quality (basic knowledge of measurement theory and experimental design, knowledge of spectroscopy, separation techniques, traditional and rapid methods of food analysis and microbiology, coupled analytical systems) 20-30 credits;

knowledge required for system-level knowledge and operation of the food chain (food safety aspects of food processing technologies, quality management, quality management, quality assurance systems, quality assurance of measurements, auditing of quality systems) 5-10 credits;

economic and human knowledge (legal and ethical regulation of food quality and safety, food marketing, management and communication skills, food economy innovation, consumer expectations for food and consumer protection) 10-15 credits;

food safety risk analysis knowledge (estimation, management and communication) 5-10 credits.

Careers:

Postgraduates may progress to PhD or find employment in food and dietetics science research, lecturing, consultancy or other science-based sectors of the food science industry. Our institute has a good relationship with food processing and qualifying enterprises and government organizations of the region.

**COURSE DESCRIPTIONS FOR FOOD SAFETY AND QUALITY ENGINEERING MSC**

The list of subjects in alphabetical order.

[Analytical and microbiological rapid methods, MTMEL7020A](https://mek.unideb.hu/sites/default/files/upload_documents/analytical_and_microbiological_rapid_methods_mtmel7020a.docx)

[Basics of food microbiology, MTMEL7006](https://mek.unideb.hu/sites/default/files/upload_documents/basics_of_food_microbiology_mtmel7006.docx)

[Biosensors and nanotechnology, MTMEL7032A](https://mek.unideb.hu/sites/default/files/upload_documents/biosensors_and_nanotechnology_mtmel7032a.docx)

Chemometry, MTMEL7041A

[Environmental aspects of food processing, MTMEL7023A](https://mek.unideb.hu/sites/default/files/upload_documents/environmental_aspects_of_food_processing_mtmel7023a.docx)

[Essential molecular cell biology, MTMEL7010A](https://mek.unideb.hu/sites/default/files/upload_documents/essential_molecular_cell_biology_mtmel7010a.docx)

[Expectation to foodstuff, consumer protection, MTMEL7002A](https://mek.unideb.hu/sites/default/files/upload_documents/expectation_to_foodstuff_consumer_protection_mtmel7002a.docx)

[Extension knowledge, MTMEL7024A](https://mek.unideb.hu/sites/default/files/upload_documents/extension_knowledge_mtmel7024a.docx)

[Food logistics, MTMEL7039A](https://mek.unideb.hu/sites/default/files/upload_documents/food_logistics_mtmel7039a.docx)

[Food marketing, MTMEL7005A](https://mek.unideb.hu/sites/default/files/upload_documents/food_marketing_mtmel7005a.docx)

[Food quality and safety risk analysis, MTMEL7021A](https://mek.unideb.hu/sites/default/files/upload_documents/food_quality_and_safety_risk_analysis_mtmel7021a.docx)

[Food safety assessment of agrochemicals, MTMEL7033A](https://mek.unideb.hu/sites/default/files/upload_documents/food_safety_assesment_of_agrochemicals_mtmel7033a.docx)

[Food toxicology, MTMEL7014A](https://mek.unideb.hu/sites/default/files/upload_documents/food_toxicology_mtmel7014a.docx)

[Food industry management and economics, MTMEL7018A](https://mek.unideb.hu/sites/default/files/upload_documents/food_industry_management_and_economics_mtmel7018a.docx)

[Hyphenated analytical methods, MTMEL7015A](https://mek.unideb.hu/sites/default/files/upload_documents/hyphenated_analytical_methods_mtmel7015a.docx)

[Innovation management, MTMEL7036A](https://mek.unideb.hu/sites/default/files/upload_documents/innovation_management_mtmel7036a.docx)

[Instrumental analytics I. (Spectroscopic methods), MTMEL7008](https://mek.unideb.hu/sites/default/files/upload_documents/instrumental_analytics_i._spectroscopyc_methods_mtmel7008.docx)

[Management and communication, MTMEL7007A](https://mek.unideb.hu/sites/default/files/upload_documents/management_and_communication_mtmel7007a.docx)

[Medicinal plants and their processing, MTMEL7025A](https://mek.unideb.hu/sites/default/files/upload_documents/medicinal_plants_and_their_processing_mtmel7025a.docx)

[Microbiological aspects of food quality and safety, MTMEL7011A](https://mek.unideb.hu/sites/default/files/upload_documents/microbiological_aspects_of_food_quality_and_safety_mtmel7011a.docx)

[Molecular background of animal product quality, MTMEL7035A](https://mek.unideb.hu/sites/default/files/upload_documents/molecular_background_of_animal_product_quality_mtmel7035a.docx)

[Molecular biology methods for food authentication, MTMEL7034A](https://mek.unideb.hu/sites/default/files/upload_documents/molecular_biology_methods_for_food_authentication_mtmel7034a.docx)

[Nutritional genetics and genomics, MTMEL7037A](https://mek.unideb.hu/sites/default/files/upload_documents/nutritional_genetics_and_genomics_mtmel7037a.docx)

[Nutritional sciences, MTMEL7009A](https://mek.unideb.hu/sites/default/files/upload_documents/nutritional_sciences_mtmel7009a.docx)

[Packaging technology, MTMEL7030A](https://mek.unideb.hu/sites/default/files/upload_documents/packaging_technology_mtmel7030a.docx)

[Proteomics in food production, MTMEL7038A](https://mek.unideb.hu/sites/default/files/upload_documents/proteomics_in_food_production_mtmel7038a.docx)

[Quality and safety of food technologies (HACCP in practice), MTMEL7004A](https://mek.unideb.hu/sites/default/files/upload_documents/quality_and_safety_of_food_technologies_haccp_in_practice_mtmel7004a.docx)

[Quality control and quality management, MTMEL7012A](https://mek.unideb.hu/sites/default/files/upload_documents/quality_control_and_quality_management_mtmel7012a.docx)

[Quality control of biological bases, MTMEL7026A](https://mek.unideb.hu/sites/default/files/upload_documents/quality_control_of_biological_bases_mtmel7026a.docx)

[Quality evaluation of food protein, MTMEL7029A](https://mek.unideb.hu/sites/default/files/upload_documents/quality_evaluation_of_food_protein_mtmel7029a.docx)

[Quality management systems and audit in the food chain, MTMEL7016A](https://mek.unideb.hu/sites/default/files/upload_documents/quality_management_systems_and_audit_in_the_food_chain_mtmel7016a.docx)

[Radiology in food industry, MTMEL7019A](https://mek.unideb.hu/sites/default/files/upload_documents/radiology_in_food_industry_mtmel7019a.docx)

[Regulation of food production, quality and safety, MTMEL7013A](https://mek.unideb.hu/sites/default/files/upload_documents/regulation_of_food_production_quality_and_safety_mtmel7013a.docx)

[Rheology in food testing, MTMEL7022A](https://mek.unideb.hu/sites/default/files/upload_documents/rheology_in_food_testing_mtmel7022a.docx)

[Separation techniques, MTMEL7003A](https://mek.unideb.hu/sites/default/files/upload_documents/separation_techniques_mtmel7003a.docx)

[Summer practice, MTMEL7GYA](https://mek.unideb.hu/sites/default/files/upload_documents/summer_practice_mtmel7gya.docx)

[Traceability in the food chain, MTMEL7017A](https://mek.unideb.hu/sites/default/files/upload_documents/traceability_in_the_food_chain_mtmel7017a.docx)

[The management of value creating processes in the food industry, MTMEL7028A](https://mek.unideb.hu/sites/default/files/upload_documents/the_management_of_value_creating_processes_in_the_food_industry_mtmel7028a.docx)

[Theory of measurement and experimental design. MTMEL7001A](https://mek.unideb.hu/sites/default/files/upload_documents/theory_of_measurement_and_experimental_design._mtmel7001a.docx)

**Analytical and microbiological rapid methods, MTMEL7020A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: practical course mark

Requirements:

- for signature: Participating in the practice.

- for a grade: Participating in the seminars, completing topic literature summary and presentation, and a written exam.

**Summary of content - theory**:

Modern methods of food analytical examinations will be introduced, with analytical analysis of the intact food materials, moreover, the electro analytical, spectroscopic examination of food. Rapid microbiological methods will be introduced: rapid microbiological tests, automatic microbiological methods. Methods examining chemical or physical characters in microbiological tests, moreover, immunological and DNA based method will be demonstrated. Students will be able to choose and perform the appropriate analytical or microbiological rapid method for the examination of food.

**lectures:**

1. Electro analytical methods: conductometry, voltammetry
2. Spectroscopic methods: IR spectrometry
3. Spectroscopic methods: NMR; Radiochemical methods.
4. Refractometry, Polarimetry
5. Chromatography: thin layer Chromatography
6. Automatization of classical microbiological analysis, Rapid hygienic tests
7. Microbiological rapid methods based on detection of physical characters.
8. Microbiological rapid methods based on detection of chemical characters.
9. Immunological methods in food microbiology.
10. Polimerase chain reaction based methods in food microbiology.

**practices:**

1. Arduino and sensors in the measurements
2. Programming of Arduino
3. Building and testing a simple photometer
4. Measurement of colour
5. Making an equipment of measurement of light scattering (turbidimetry and nephelometry
6. Characterise microbiological rapid methods for determining the numbers of microorganisms
7. Finding application possibilities for the microbiological rapid methods based on detection of physical characters
8. Finding application possibilities for the chemical based microbiological rapid methods
9. Finding application possibilities of immunological rapid methods for food microbial analysis
10. Set up a plan for PCR detection of a foodborne pathogen.

**Literature**

https://www.arduino.cc/en/Booklet/HomePage

Püssa T (2013): Principles of Food Toxicology. CRC press. ISBN 9781466504103

Omaya S. T (2004): Food and Nutritional Toxicology. CRC press. ISBN 9781587160714

D'Mello J P F (2003): Food Safety: Contaminants and Toxins CABI, 480p

Madigan, M. T, Martinko, J. M., Bender K., Buckley, D., Stahl, D (2015): Brock Biology of Microorganisms, Benjamin Cumming, 14th edition 1030 oldal, ISBN 978-1-292-01831-7

**Basics of food microbiology, MTMEL7006**

ECTS Credit Points: 3

28 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: exam mark

Requirements:

- for signature: Participating in the practice.

- for a grade: Participating in the seminars, completing topic literature summary and presentation, and a written exam.

**Summary of content - theory**:

The aim of the subject is the introduction of the subject, task and history of food microbiology, internal and external factors that influence the safety and quality of raw materials and finished products.

**lectures:**

1. Metabolism and culture of microbes.
2. Structure of prokaryotic cells.
3. Structure of eukaryotic cells.
4. Basic microbial genetics.
5. Methods of microbial taxonomy.
6. Most important prokaryotic taxons and their characteristics.
7. Characteristics and taxonomy of fungi.
8. Characteristics and taxonomy of protozoa.
9. Extrinsic parameters of foods that affect microbial growth.
10. Intrinsic parameters of foods that affect microbial growth.
11. Physical preservation methods
12. Chemical preservation methods
13. Biological preservation methods
14. New techniques for food preservations.

**practices:**

1. Recognize the role of the different culture medium components
2. Find examples for the role of the different genetic elements of the foodborne bacteria
3. Practice nomenclature and identification
4. Recognize the different morphological characteristics of bacteria and use the correct expression
5. Recognize the difference between the Gram-positive and Gram-negative cell walls
6. Recognize the difference between the three domains of life
7. Recognize the important morphological characters of important fungal species
8. Collect information about foodborne protozoa
9. Collect information about foodborne animal parasites
10. Find if a food is provide growth for a foodborne pathogen based on its water activity
11. Find if a food is provide growth for a foodborne pathogen based on its pH minimum and maximum only
12. Describe the growth characteristics of foodborne pathogens at different temperatures

**Literature:**

Madigan, M. T, Martinko, J. M., Bender K., Buckley, D., Stahl, D (2015): Brock Biology of Microorganisms, Benjamin Cumming, 14th edition 1030 oldal, ISBN 978-1-292-01831-7

Karaffa, E. – Peles, F. (2015): Microbiological aspects of food quality and safety. University lecture notes. University of Debrecen. TÁMOP-4.1.2.D-12/1/KONV-2012-0008. 110p.

Doyle, M.P. - Buchanan, R.L. (2013): Food Microbiology: Fundamentals and Frontiers. 4th edition. ASM Press, Washington. 1118p.

Adams, M.R. - Moss, M.O. (2008): Food Microbiology. 3rd edition. RSC Publishing. 478p.

**Biosensors and nanotechnology, MTMEL7032A**

ECTS Credit Points: 4

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written or oral exam

Requirements:

- for signature: Participating in 60% of the practices.

- for a grade: Practical test.

**Summary of content - theory**

**lectures:**

1. The operating principle and application areas of various chemical sensors. (Macro and Micro Sensors).
2. Electrochemical sensors: potentiometric, conductometric, amperometric. Optical sensors. Piezoelectric sensors. Thermal sensors.
3. Biosensors and their application. (Macro and Micro Sensors). The physicochemical, biochemical and technological basis of biosensors. Metabolismsenzors. Affinitysenzors. Biosensors in Clinical Chemistry Laboratory: Practical Applications. Use of biocompatible materials.
4. Immun analytical methods. Sensors produced by technologies used in the microelectronics industry. The concept, the distribution, the characteristics of sensors, intelligent and integrated sensors, novel requirements. Special types of materials and technologies.
5. Instrument Structures in Sensors: Impedance Structures, Semiconductor Devices, Electrochemical Cells, Calorimetric Resonators, and Fiber Optic Types.
6. The basic properties of the transformation are: - the effects of temperature: thermoresistive and thermoelectric, piroelectric effect - mechanical stress and deformation effects: piezoelectric, piezoresistive effect, capacity change, electrets - effects of the magnetic field: charge rejection Hall effect, magnetoresistive effect, superconductivity - effects of radiation: thermal and quantum effects.
7. Molecular interactions of chemical transformation: adsorption, absorption, ion exchange, the possibilities of chemical optical transformation, the basics of bio sensors.
8. Physical sensors and their applications in medical biology: temperature measurement, other applications of temperature sensors, applications of mechanical sensors, ultrasonic sensors in echography, nuclear detectors in radiology, applications of magnetic sensors, flow measurement. Chemical sensors and their applications in medical biology: blood gas concentrations and pH sensors (invasive and transcutaneous
9. Electrochemical sensors, fiber optic sensors, combined types), oximetry, ion selective sensors, pH measurement in the digestive tract, determination and mapping of tissue pH / pO2. Bio sensors: enzymatic or Biocatalytic sensors (principles, glucose sensors, additional biocatalytic sensors, affinity bio sensors (immunoassays, DNA chips), live biosensors.
10. Fundamentals of nanotechnology. Mitigation and new phenomena, properties, techniques.
11. The tools of nanotechnology I. Classical (optical and electron) microscopy.
12. Scan scanning microscopy. Scanning Tunnel Microscope (STM), Nuclear Power Microscope (AFM). Atomic level solving and manipulation. III. Electron and ion beam machining.
13. Materials of nanotechnology, metal nanoparticles, carbon nanostructures, biotechnology methods for producing nanoscale particles.
14. Applications. Micro and nanoactivators, micro and nanofluidic devices. Applications: optical systems, lab-on-chip concept.

**practices:**

1. Arduino and sensors (4 hours)
2. Programming of Arduino (4 hours)
3. Testing of sensors 1: temperature (2 hours)
4. Testing of sensors 1: pressure (2 hours)
5. Testing of sensors 1: weight (2 hours)
6. Testing of sensors 1: water activity (2 hours)
7. Producing of selenium nanoparticles with chemical method (4 hours)
8. Producing of selenium nanoparticles by biotechnology (4 hours)
9. Testing of toxicity of nanoparticles (4 hours)

**Literature:**

Biosensors: Theory and Applications Donald G. Buerk 1995 by CRC Press ISBN 9780877629757

Chemical Sensors and Biosensors: Fundamentals and Applications Florinel-Gabriel Bănică ISBN: 9780470710661 2012 John Wiley & Sons, Ltd

Electrochemical Sensors, Biosensors and their Biomedical Applications Xueji Zhang, Huangxian Ju and Joseph Wang ISBN: 978-0-12-373738-0 2008 Elsevier Inc

Textbook of Nanoscience and Nanotechnology B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday ISBN: 978-3-642-28029-0

**Chemometry MTBE7043A**

ECTS Credit Points: 3

14 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: Practice grade

Requirements:

- for signature: Attendance to lectures/seminars

- for a grade: practice grade, essays

**Summary of content - theory**:

The development and application of sensitive and selective analytical methods is required for the effective development and quality control in the food industry. One can recently witness a silent revolution either in the process automation and or in analytical technology. The food industry is a part of this evolution. Various companies offer PAT (process analytical technology) systems based on image and spectroscopic sensory (NIR, RAMAN) analysis. These technical solutions are

presented by dozens of spectacular booklets and more or less well trained service engineers. Less information is provided about how the actual qualitative and quantitative results are computed from the sensor signals. Although for a company it is crucial for the in-house development and maintenance of a PAT system customized for a product or production step using the existing expert team. This course offers a basic insight into the most widely used multivariate classification and calibration techniques with easily understandable practical examples.

**lectures:**

1-2. Introduction to the spectroscopic methods, interaction of the material and the electromagnetic radiation, methods and sensors in the daily routine

3-4. Evolution and properties of spectra. Construction of data matrices, visual observation, basic descriptive statistical tools.

5-6. Classification methods (I): factor analysis, PCA (principal component analysis), LDA (linear

discriminant analysis)

7-8. Classification methods (II):), ANN (artificial neural networks), SIMCA (self-independent modelling of class analogies) , SVM (support vector machines), cluster analysis

9-10. Regression methods (I): linear and multilinear regression, PCR (principal component regression)

11-12. Regression methods (II): PLS, PLS-DA (partial least squares regression and discriminant analysis)

13-14. Internal and external validation

**practices:**

1-4. Non-destructive determination of elemental composition of alloys and its use in classification models

5-8. RAMAN spectrum recording and classification of various cheese samples (PCA, LDA)

9-12. Determination of food dye concentration by image analysis and multivariate regression (PLS, PCR)

13-14. Application of NIR spectroscopy in the analysis of different skin types (LDA, SIMCA)

**Literature, handbooks in English**

Füstös László: A sokváltozós adatelemzés módszerei, Módszertani Füzetek, 2009/1.

S.N. Deming, Y. Michotte, D.L. Massart, L. Kaufman, B.G.M. Vandeginste: Chemometrics:

A Textbook, Elsevier, 1988

**Environmental Aspects of Food Processing, MTMEL7023A**

ECTS Credit Points: 4

42 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Active participation at the lessons is required.

- for a grade: Written exam.

**Summary of content - theory**

**lectures:**

1. Basics of environmental status of a country. Definition, structure and development of environmental protection and environmental management. Natural resources and their types, continuous, non-renewable, and renewable natural resources. The concept of environment, its elements, pollution sources, causes, forms.
2. Air pollution and pollution control.
3. Soil contamination and degradation: soil contamination and contaminants, erosion.
4. Water pollution and protection against pollution. Water quality, water quality protection. The system of Water Management.
5. Noise and vibration protection.
6. Waste management: The concept of waste, its sources and effects.
7. International scope of agri-environmental management. Introduction of the Hungarian practice as an example.
8. The impact of agricultural production on the environment: environmental effects of plant production, environmental aspects of animal husbandry. Environmental impact assessments.
9. General environmental impacts of food production and processing.
10. Specific environmental effects of food production and processing I.
11. Specific environmental effects of food production and processing II.
12. Cleaner production techniques.
13. Environmental management systems.
14. Life cycle analysis. Environmental indicators. BAT (Best Available Techniques).

**Literature:**

J. C. Lovett- D. G. Ockwell.: 2010. A Handbook of Environmental Management.

J.M. Blais, M. Rosen, J.P. Smol.: 2015. Environmental Contaminants.

A. S. Kalamdhad, J. Singh, K. Dhamodharan.: 2016. Advances in Waste Management.

V. I. Grover.: 2006. Water: Global Common and Global Problems.

**Essential molecular cell biology, MTMEL7010A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Written and oral exam

- for a grade: 2 essays on given topic.

**Summary of content – theory**

Students will understand and the structural and functional properties of eukaryotic cells, and will learn to analyze and interpret the spatial and temporal control of stochastic and determinative cellular phenomena in the context of cellular compartmentalization, cell cycle regulation, genomic integrity and evolution.

**lectures:**

1-3. Analysis of cellular and molecular levels of organization of living material, and system biology type of investigation methods.

4-5. Regulation of eukaryotic gene expression: transcription, translation, protein folding and degradation. The genomic integrity.

6-7. Epigenetic regulation of gene expression. Morphogenetic events and cell differentiation. Diurnal cycle.

8-9. Eukaryotic cells metabolism and energetic management, and the regulation of cellular homeostasis.

10-11. Cellular redox potential, ageing and adaptive stress responses.

12-13. Transgenic organisms and genetically modified foods.

14. The cellular basis of personalized nutrition.

**Summary of content - practice**:

Students will carry out different molecular experiments in order to learn about the basic molecular and bioinformatics investigation methods.

1-2. Assessment of cellular toxicity.

3-4. Molecular investigation methods.

5-8. PCR cloning, CRISP/CAS9 genome editing and analysis of transgenic organisms.

9-10. Data mining using bioinformatics databases.

11-14. In silico genome-, proteome- and interactome analysis.

**Literature, handbooks**

Alberts, B., Brey, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. (2016). Essential cell biology. 4th edition. Garland Science, Taylor & Francis Group, New York, USA. ISBN-13: 978-0815344544

Alberts, B., Johnson, A, Lewis, J. Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of the Cell. Sixth Edition. Garland Science, Taylor & Francis Group, New York. ISBN-13: 978-0815344322

Pollard, T.D., Earnshaw, W.C., Lippincott-Schwartz, J. and Johnson, G. (2017). Cell Biology, 3rd Edition, Elsevier, ISBN: 9780323341264

PUBMED database

**Expectation to foodstuff, consumer protection, MTMEL7002A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Test

- for a grade: Successful test (60%) and participation in practices

**Summary of content - theory**:

The main aim of the lectures is to know the organisations, regulations and requirements which aims the production of safe food and consumer protection. Students will know the procedure of authorisation, the usage of applicable materials in food production, the requirements for trade in the EU and for import from third countries.

**lectures:**

1. 178/2002/EC regulation
2. Labelling of food
3. Trademarks and other labels
4. Consumer behaviours
5. Food contaminants
6. Treatments and materials
7. Foods with distinctive quality indication
8. Foods for particular nutritional use
9. Trade inside the EU
10. Import from third countries in the EU
11. Authorisation and registration of food business
12. Catering
13. Communal catering
14. Test

**Summary of content - practice**:

The main aim of the practices is to expand the lecture’s knowledge with example tasks and case studies.

**practices:**

1. RASFF system
2. Nutrition declaration
3. Geographical indicators and traditional specialities guaranteed
4. Five keys to safer food manual
5. Foodborne diseases
6. Vitamins and minerals
7. Public health product tax
8. Vulnerable groups
9. Manufacturing formula
10. Physical check at the border inspection post
11. Food and food chain inspection fines
12. Nutrition and health requirement for catering
13. Presentations
14. Presentations

**Literature, handbooks in English**

J.L. Pomeranz (2016): Food law for public health. Oxford University Press., New York.

J. Albert (2010): Innovations and food labelling. ISBN 978-1-84569-759-4

Regulaion, directives

**Extension knowledge, MTMEL7024A**

ECTS Credit Points: 3

28 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Completing assignments / exercises, passing a problem solving test.

- for a grade: Colloquium

**Summary of content**

Extension knowledge is an integral part of our everyday lives. The course, based on the theoretical background, presents the practice of consulting systems. The students will be going to know the most important planning tools and gain insight their application as well.

**lectures:**

1. Business consulting: Orientation, course overview
2. Basement of Business Consulting, Definition of Business Consulting, Areas of Business Consulting, Main specifications of consulting, BC - Main characteristics and roles in Domestic Economy, Reasons of Needs of BC, Types of BC, Pyramid of Consultancy, Main characteristics of Business Consultant, Main features of Business Consultant
3. Decision Making, Types of decisions, Forms of Business Consulting
4. Process of Business Consulting, Networking, building up new business relations
5. Business Consulting Methods

**Literature, handbooks**

Gerald M. Weinberg - The Secrets of Consulting: A Guide to Giving and Getting Advice Successfully

ppt materials of the lectures

**Food industry management and economics, MTMEL7018A**

**Name and code of the subject: Food industry management and economics** MTMEL7018A

**Name and title of the person responsible for the subject:** Dr. Buzás Ferenc PhD

**Additional instructors involved in teaching the subject:** no

**Name and level of the program:** Élelmiszerbiztonsági és -minőségi mérnöki (angol) MSc

**Subject type:** compulsory

**Teaching timetable of the subject, type of examination:** 2+1 K

**Credit value of the subject: 3**

**Purpose of teaching the subject:** To familiarize the students with the strategic knowledge, acquire the strategic considerations of food industrial plants, methodology of competitiveness analysis, the possibilities of competitiveness analysis of enterprises. The students recognize the circumstances of economic and managerial function of food industrial plants, prepare the feasibility study, get acquainted with the conditions of implementation and functioning of food industrial enterprises and plants.

**Content of the subject (14 weeks):**

1. The strategy of food industry enterprise

2. Strategic management, leader’s tasks

3. The condition of implementation of food industry plants

4. External environment analyses of food industry plants

5. Analyses of industry branches, market structures

6. Technological conditions of food industry plants

7. Business tasks in food industrial enterprises

8. Logistic and marketing tasks in food industrial enterprises.

9. Internal environment analysis of food industries

10. The financing of food industries, cost and pricing analysis

11. Investment and cash-flow analysis

12. The environment management of food industry enterprise

13. Application possibilities and project management

14. Evaluation of the project / business plan

**Type of mid-term examination:** no mid-term examination. The verification of the project is continuous.

**Method of assessment (semester examination mark - report, practical grade, colloquium, examination):**

Writing exam and practical course mark (businness project in .xls format). Final note will be the average of the exam and project. The attendance on practical lectures is obligatory.

**Teaching aids: lectures ppt, and the syllabus**

**Recommended literature:**

1. Practical exercises for the course of Food Industry management. UD-Faculty of Agricultural and Food Sciences, and Environmental Management. e-syllabus. Debrecen.
2. CSIP consortium (2016): The competitive position of the European food and drink industry Final report. European Commission B-1049 Brussels. Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs Programme for the Competitiveness of Enterprises and small and medium-sized enterprises (COSME)

[*http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item\_id=8677&lang=en*](http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8677&lang=en)

1. G. D. Saravacos and Z. B. Maroulis (2007): Food Plant Economics CRC Press 2007. ISBN: 978-0-8493-4021-5
2. G. D. Saravacos and Z. B. Maroulis (2007): Food Plant Economics CRC Press 2007. ISBN: 978-0-8493-4021-5
3. Connor, John, and William Schiek. Food Processing: An Industrial Powerhouse in Transition. New York: John Wiley and Sons, 1997.

**Food logistics, MTMEL7039A**

ECTS Credit Points: 4

14 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Giving presentation. Courses have to be attended as it is in the regulations. Additional requirements are those that must be met by each student within the semester and are specified and communicated by the course master. These requirements are definitely related to the topics discussed in the course.

- for a grade: Written examination that may result in a grade from 1 to 5 which grade will be calculated as a combined one with those results coming from the performances (presentations) over the semester.

**Summary of content – theory**

Course objectives: To get students acquainted with the theoretical and practical parts of logistics and their applications in the chain. Our aim is to introduce the basics of modern logistics based on the main functions and processes serving the goods flow.

Introduction to supply chain and logistics management

**lectures:**

1. Introduction to supply chain and logistics management
2. Food supply chains
3. Logistics
4. Retailing
5. Production and Manufacturing
6. Sourcing and procurement
7. Technology trends in supply chains
8. Risk management
9. Regulation, safety and quality
10. Collaboration and relationship
11. Security and future challenges
12. Challenges in international supply chains
13. Supply chain and logistics performance
14. Sustainability in supply chains

**Summary of content - practice**:

Skills to be learnt: Students will be able to evaluate and discuss specific cases using their knowledge gained about theory on lectures.

**practices:**

1. case examples for commerce and trade
2. case examples for supply chains and logistics
3. case examples for logistics systems
4. case examples for retailing
5. Food manufacturing and internal supply chains; case examples
6. sourcing and purchasing models; case examples
7. technology trends in the food supply chains; case examples
8. managing risks in the supply chain; case examples
9. Food regulation, safety and quality seminar: case examples
10. models and trends in the food sector; case examples
11. food security and future challenges; case examples
12. managing challenges in international food supply chains; case examples
13. Food supply chain and logistics performance; case examples
14. sustainability challenges in food supply chains; case examples

**Literature, handbooks**

Dani, S. (2015): Food supply chain management and logistics. pp 260, KoganPage, ISBN: 9780 7494 7364 8

Deloitte (2013): The food value chain: a challenge for the next century. Deloitte Touche Tohmatsu, London.

**Food Marketing, MTMEL7005A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Practice visits are compulsory. Missing is possible up to 30% of the seminars. Students must process a case study in the field of food marketing by the end of the semester with an oral presentation.

- for a grade: Students must process a case study in the field of food marketing by the end of the semester with an oral presentation. Students must complete a written exam at the end of the semester. The presentation and the written exam will be evaluated together. Students can earn 100 points during the semester. The presentation is 50% (50 points), with 50% (50 points) for the written exam. Students must also meet the minimum level for presentation and written exam, so they need to reach 51% of the points. During the semester students can earn extra points through active participation in the lessons.

Presentation (50% of the final 100 points): During the oral presentation, students should be given 10 minutes of the lectures and they will present it on one of the last lessons.

Written exam (50% of the final 100 points): The written exam consists of five sections (multiple choices (10 points), true or false (10 points) and three short essays (3\*10 points). Students will write the exam during the exam period or pre-exam with the appropriate progress of the semester.

**Name and code of the subject:** Élelmiszer marketing (Food Marketing) MTMEL7005A

**Name and title of the person responsible for the subject:** Dr. András Fehér

**Additional instructors involved in teaching the subject:** -

**Name and level of the program:** Food safety and quality engineer sciences (Master)

**Subject type:** compulsory

**Teaching timetable of the subject, type of examination:** 2+1 K

**Credit value of the subject:** 3

**Purpose of teaching the subject:** The goal of the subject is to make the student understand the basic contexts of the food marketing especially the segmentation, the targeting and positioning. The subject emphasizes the role of the marketing mix in the food markets therefore we study the product, the price, the place and promotion tools detailed. The community marketing tools and strategies are also part of the subject.

**Content of the subject (14 weeks):**

**Lecture topics:**

1. Coordination of the requirements
2. Evolution of food marketing system – part 1.
3. Evolution of food marketing system – part 2.
4. Segmentation and new product development (from concept to shop), STP, product, price, place and promotion – part 1.
5. Segmentation and new product development (from concept to shop), STP, product, price, place and promotion – part 2.
6. Food consumption trends – part 1.
7. Food consumption trends – part 2.
8. Regional food systems – part 1.
9. Regional food systems – part 2.
10. Retailers strategies in fresh produce (case study: Short supply chains) – part 1.
11. Retailers strategies in fresh produce (case study: Short supply chains) – part 2.
12. Overview of a specific products' market (free from products) – part 1.
13. Overview of a specific products' market (free from products) – part 1.
14. Final presentation / semester summary

**Practice topics**

1. Coordination of the requirements
2. Evolution of marketing systems – Coca-Cola, the prime example of marketing – Case study analysis
3. Evolution of marketing systems – Coca-Cola, the prime example of marketing – Case study presentation
4. Segmentation and new product development – Red Bull, the brand getting wings – Case study analysis
5. Segmentation and new product development – Red Bull, the brand getting wings – Case study presentation
6. Food consumption trends – The characteristic of digital food consumer – Case study analysis
7. Food consumption trends – The characteristic of digital food consumer – Case study presentation
8. Regional food systems –Gedeon Totth – International practice of community agricultural marketing – Case study analysis
9. Regional food systems –Gedeon Totth – International practice of community agricultural marketing – Case study presentation
10. Retailer’s strategies in fresh produce – Tesco, the world-class customer contact builder – Case study analysis
11. Retailer’s strategies in fresh produce – Tesco, the world-class customer contact builder – Case study presentation
12. Overview of specific products’ market –The story of delicious gluten free bread: the branding of Glulu – Case study analysis
13. Overview of specific products’ market –The story of delicious gluten free bread: the branding of Glulu – Case study presentation
14. The student present the final presentation.

**Type of mid-term examination:** -

**Method of assessment (semester examination mark - report, practical grade, colloquium, examination):**

Students must process a case study in the field of food marketing by the end of the semester by an oral presentation. Students must complete a written exam at the end of the semester.

The presentation and the written exam will be evaluated together.

Students can earn 100 points during the semester. The presentation is 50% (50 points), with 50% (50 points) for written exam. Students must also meet the minimum level for presentation and written exam, so they need to reach 51% of the points. During the semester students can earn extra points through active participation in the lessons.

Presentation (50% of the final 100 points): During the oral presentation, students should be given 10 minutes of lectures and they will be present it in one of the last lessons.

Written exam (50% of the final 100 points): The written exam consists of five sections (multiple choices (10 points), true or false (10 points) and three short essays (3\*10 points). Students will write the exam during the exam period or pre-exam with the appropriate progress of the semester.

**Teaching aids:** Collection of case studies

**Recommended literature:**

1. Rachel E. Helwig (2015): Transparent Food Marketing: A Clear Understanding of Food Marketing Terminology. CreateSpace Independent Publishing Platform; First edition. pp. 1-112 ISBN: 9781514869864
2. Stephen F. Hall (2015): Sell Your Specialty Food: Market, Distribute, and Profit from Your Kitchen Creation. Stephen F. Hall; 6th edition. pp. 1-210. ISBN: 9780692572078
3. Gordon W. Fuller (2011): New Food Product Development: From Concept to Marketplace, Third Edition. CRC Press; 3 edition. pp. 1-508. ISBN: 9781439818640

**Food quality and safety risk analysis, MTMEL7021A**

ECTS Credit Points: 5

42 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: written or oral exam

Requirements:

- for signature: Participation in practices and presentation

- for a grade: Exam

**Summary of content – theory**

Course objectives: The main aim of the lectures is to know the physical, chemical and biological/microbiological hazards which have important effects on food safety and food quality. Student will know different foodborne diseases that are caused by different bacteria and parasites. In this semester, students will know the methodology of risk analysis (mainly the risk assessment) and the methodology of the determination of tolerable intakes and other toxicological values.

**lectures:**

1. Introduction to food safety
2. Introduction to toxicology
3. Chemical hazards
4. Microbiological hazards
5. Preliminary risk management activities
6. Risk management and risk communication
7. Chemical risk assessment
8. Hazards of genetically modified plants and foods
9. Risk-based categorization of food business

**Summary of content - practice**:

Skills to be learnt: The main aim of the practices is to expand the lecture’s knowledge with example tasks and case studies. Therefore the students explore case-studies and make exercises which help them to develop their abilities for the assessment of risks and hazards and for exposure assessment.

**practices:**

1. Influencing factors of food safety
2. Human exposure assessment
3. The dose-response relationship
4. Tolerable intake and risks
5. Risk profile
6. Risk ranking
7. Case studies for chemical risk assessment
8. Risiko (risk) assessment
9. English model for risk-based categorisation of food business

**Literature, handbooks**

WHO (2000): Human Exposure Assessment (Environmental Health Criteria; 214). Geneva, Switzerland

WHO (2010): WHO Human Health Risk Assessment Toolkit: Chemical Hazards. Geneva, Switzerland

Tulve et al. (2016): Guidelines for Human Exposure Assessment. U.S. EPA

**Food safety assessment of agrochemicals, MTMEL7033A**

ECTS Credit Points: 3

28 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: colloquium

Requirements:

- for signature: Attendance at lectures is recommended, but not compulsory. . Students must give presentation once during the semester. Completing assignments / exercises

- for a grade: written exam

**Summary of content – theory**

Impact of pesticide residues on human body, possibilities of avoiding them. Analyzes of pesticides.

**lectures:**

1. week: Chemistry of crop enhancers, grouped by their food safety hazard

2-4. weeks: Plant protection products used in modern plant protection, biological plant protection, food safety aspects of different plant protection methods

5-6. weeks: Investigation of the change of the pesticide concentration and its degradation under controlled experimental conditions

7-8 weeks: Effects of plant protection products on the human body

9-10 weeks: Use of fertilizers, hazards of use, impact on the environment and human body

11-12 weeks: Detection of plant protection products and fertilizers using modern bioanalytical methods

13. week: Sampling procedures

14. week: Methods for evaluating test results,

15. week: Plants, fertilizers, biological plant protection benefits, disadvantages, evaluation in the light of food safety

**Literature, handbooks**

Árpád Ambrus and Denis Hamilton: Protein Structure: Food Safety Assessment of Pesticide Residues (2017)

**Food toxicology, MTMEL7014A**

**Name and code of the subject:** MTMEL7014A

**Name and title of the person responsible for the subject:** Dr. Prokisch József, associate professor

**Additional instructors involved in teaching the subject:** Remenyik Judit, Fazekas Mónika

**Name and level of the program:** Food safety and quality engineering, MSc

**Subject type:** compulsory

**Teaching timetable of the subject, type of examination:**  2+2, Written exam

**Credit value of the subject:** 4

**Purpose of teaching the subject:**

The course provides the student with a background of major groups of toxic substances encountered by man and animals through the food and environment, and also through exposure at the workplace. These toxicants include metals, naturally occurring toxins, solvents, pesticides, pollutants and radiation (UV, electromagnetic, ionizing). The course focuses on the chemistry, fate and distribution in the food and environment, mechanisms of their actions, toxic manifestation in living organisms as well as toxic syndrome in human beings. after the theoretical part, the course is concluded with “case histories”. These are actual, realistic and generally well known cases or scenarios (e.g. the fall of DDT, the Minimata Bay incident, the dioxin-food problem, etc.) and are used to elucidate the particular topic.

**Content of the subject (14 weeks):**

1. Introduction, interesting facts, special cases,

2. Basic concepts of toxicology

3. History of toxicology, current practice,

4. Toxicology of arsenic

5. Lead, mercury, cadmium

6. Chromium, selenium, other metals

7. Toxicology of gases (CO, CO2, O2, N2, HCN, NH3, SOx, NOx, N2O, NH3,…)

8. VOC, PAH, PCB

9. Plant protection products

10. Radioactivity and toxicology

11. Plant and animal poisons

12. Chemical and biological weapons

13. Risk assessment

14. Case studies

**Type of mid-term examination: student presentation**

**Method of assessment (semester examination mark - report, practical grade, colloquium, examination): Oral or written exam**

**Teaching aids:** case studyvideos, ppt

**Recommended literature:**

1. Michael J. Derelanko- Mannfred A. Hollinger: CRC Handbook of Toxicology 1995
2. Descotes J.: Human Toxicology. Elsevier, 1987
3. Vernet J.P.: Heavy Metals in the Environment. Elsevier, 1991
4. Nutritional Toxicology Second Edition by Frank Kotsonis and Maureen Mackey
5. ATSDR home page: http://www.atsdr.cdc.gov/
6. Vettorazzi, G.: Handbook of international food regulatory toxicology. Food Additives. Sp. Medical & Scientific Books,New York, 1981
7. Principles for the Safety Assessment of Food Additives and Contaminants in Food Enviromental Health Criteria 70 World Health Organization, Geneva, 1987

**Hyphenated analytical methods, MTMEL7015A**

**Name and code of the subject: Hyphenated analytical methods, MTMEL7015A**

**Name and title of the person responsible for the subject:** Dr. Béni Áron, associate professor

**Additional instructors involved in teaching the subject: -**

**Name and level of the program:** Food Safety and Quality Engineering MSc

**Subject type: lecture and laboratory practice**

**Teaching timetable of the subject, type of examination:** 1+1 C

**Credit value of the subject: 3**

**Purpose of teaching the subject:**

The task of the subject is: the students get acquainted with the grouping and applicability of the most important attached analytical systems. The students will get a detailed educational material (theoretical and practical knowledge) for the most important attached analytical systems (HPLC–UV/VIS and HPLC–DAD, HPLC–ICP-MS, LC-MS, GC-MS). It will detail the importance and process of the speciation analytics, moreover it will give specific examples for application of an attached analytical system.

**Content of the subject (14 weeks):**

***The topics of the lectures:***

**1. week:** grouping of the attached techniques.

**2-3. weeks:** application possibilities of HPLC–UV/VIS and HPLC–DAD systems

**4-5. weeks:** separation and detection possibilities of elemental speciation analytical methods (HPLC–ICP-OES, HPLC–ICP-MS, moreover non-chromatographic analytical methods)

**6. week:** advantages and disadvantages of different elemental speciation analytical methods

**7-8. weeks:** sampling and sample preparation methods for elemental speciation analytical methods

**9. week:** application possibilities of a liquid chromatograph mass spectrometer (LC-MS)

**10. week:** application possibilities of gas chromatograph mass spectrometer (GC-MS)

**11. week:** introduction and possibilities of analytical techniques of arsenic species

**12. week:** introduction and possibilities of analytical techniques of selenium species

**13. week:** introduction and possibilities of analytical techniques of mercury species

**14. week:** introduction and possibilities of analytical techniques for species of other elements

***The topics of laboratory exercises:***

**1. week:** education of prevention of accidents, introduction of laboratory order and each laboratory exercises

**2-3. weeks:** sampling and sample preparation methods of food raw materials and food productions for elemental speciation analyses

**4-5. weeks:** sampling and sample preparation methods of food raw materials and food productions for determination of organic compounds

**6-8. weeks:** analysis of chromium(III) and chromium(VI) species contents in the previously prepared samples of food raw material and food production using aluminium-oxide micro column and inductively coupled plasma optical emission spectrometer (MC–ICP-OES).

**9-11. weeks:** analysis of selenium(IV) and selenium(VI) species contents in the previously prepared samples of food raw material and food production using ion chromatograph and inductively coupled plasma mass spectrometer (IC–ICP-MS).

**12-14. weeks:** identification and analysis of contents of various organic compounds in the previously prepared samples of food raw material and food production using gas chromatograph–mass spectrometer

**Type of mid-term examination:**

Have to write one test, it must reach above 50% of points.

Attendance at the practice is mandatory

**Method of assessment (semester examination mark - report, practical grade, colloquium, examination):**

After the successfully written test, the oral exam is available.

The percentage of the points conversion to grades:

80 – 100 5

70 – 79 4

60 – 69 3

50 – 59 2

0 – 49 not accepted (1)

**Teaching aids:**

Dr. Áron Béni E-learning Hyphenated analytical methods

Dr. Áron Béni Practical Exercises for the Course ofHyphenated Analytical Techniques

Dr. Rita Erdeiné Kremper Practical Exercises for the Course of Genearal and Inorganic Chemistry

**Recommended literature:**

1.       Cornelis, R., Crews, H., Caruso, J., Heumann, K. 2003. Handbook of Elemental Speciation: Techniques and Methodology John Wiley & Sons, Ltd. ISBN: 0-471-49214-0

2.       Cornelis, R., Crews, H., Caruso, J., Heumann, K (editor) 2005. Handbook of Elemental Speciation II: Species in the Environment, Food, Medicine & Occupational Health. John Wiley & Sons, Ltd. ISBN: 0-470-85598-3 (HB)

3.       Ure, A.M., Davidson, C.M. 2002. Chemical Speciation in the Environment, Blackwell Science Ltd. ISBN 0-632-05848-X

4.       Joanna Szpunar, J., Lobinski, R. (Editors) 2003. Hyphenated Techniques in Speciation Analysis. The Royal Society of Chemistry. Cambridge, UK. 252 p. ISBN: 978-0-85404-545-7

5.        Ruth Waddell, Cris Lewis, Wei Hang, Chris Hassell and Vahid Majidi: (2005) Inductively Coupled Plasma Mass Spectrometry for Elemental Speciation: Applications in the New Millennium. Applied Spectroscopy Reviews, 40:33–69.

**Innovation management, MTMEL7036A**

ECTS Credit Points: 3

14 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Completing assignments / exercises, Submitting essay, giving presentation.

Attendance is required in seminars. Students are required to write an essay and give a presentation in the field of management.

Participation at **practice** is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Active participation is evaluated by the teacher. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests, students have to sit for the tests.

- for a grade: Students final grade is added from their activity of middle term work and their written exam grade.   
The calculation is the following: <60% – 1; 61% – 2; 71% – 3; 81% – 4; 91%– 5.

**Summary of content – theory**

Course objectives: This subject gives a thinking frame and practical methodology of preparation for innovational managerial decision making and implementation. Their knowledge can be used for modernizing products, services, processes, technologies, Competitiveness increasing of for-profit and nonprofit sectors and renewing of elements of organizational systems.

**lectures:**

1. What is innovation? (definition, process)
2. Conceptions, models of innovation
3. Strategy of innovation
4. Financing of innovation
5. Management of innovation
6. Management of technology
7. Measurement of innovation
8. Influence of innovation
9. Methodology of innovation
10. European policy of innovation
11. American policy of innovation
12. Asian policy of innovation
13. Creative industry and innovation
14. Environment of innovation

**practices:**

1. creativity training 1.
2. creativity training 2.
3. creativity training 3.
4. case study 1.
5. case study 2.
6. case study 3.
7. case study 4.
8. case study 5.
9. case study 6.
10. case study 7
11. case study 8
12. case study 9
13. case study 10
14. case study, summarising, valuating

**Literature, handbooks**

Trott, Paul (2017): Innovation Management and New Product Development. Prentice Hall. Harlow England (6. ed)

[Joe Tidd](http://www.worldcat.org/search?q=au%3ATidd%2C+Joe&qt=hot_author); [John Bessant](http://www.worldcat.org/search?q=au%3ABessant%2C+John&qt=hot_author) (2016): Managing innovation: integrating technological, market and organizational change. Chichester, West Sussex: Wiley (5-th ed)

S. Maital - D.V.R. Seshadri (2007): Innovation management. Sage Publications Ltd London

E.G. Carayannis et al., (2015) *Innovation and Entrepreneurship*, Innovation, Technology, and Knowledge Management, Springer International Publishing Switzerland, DOI 10.1007/978-3-319-11242-8\_2

Scott Shane (ed): Handbook of Technology and Innovation Management, A John Wiley and Sons, Ltd.,

http://bookboon.com/en/management-and-strategy-ebooks

**Instrumental analytics I. (Spectroscopyc methods), MTMEL7008**

ECTS Credit Points: 5

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: oral exam

Requirements:

- for signature: Participate in the practices and successful practice tests

- for a grade: Completing laboratory exercises, Oral exam (2 questions)

**Summary of content – theory**

The basic objective of the course is to acquaint students with the knowledge of the most important spectroscopyc methods of the instrumental chemical analytical techniques required to determine the quality and chemical components of food, food raw materials and food ingredients.

**lectures:**

1-2.: The simplified diagram of a multielemental chemical analysis

3.: The performance characteristics of analytical methods

4.: UV-VIS absorption spectrophotometry

4.: General description of spectroscopic methods

5-6.: Flame atomic absorption spectrometry (FAAS).

7.: Graphite furnace atomic absorption spectrometry (GF-AAS)

8.: The interference effects of FAAS and GF-AAS techniques and their eliminations

9-10.: Inductively coupled plasma optical emission spectrometry (ICP-OES)

11-12.: Inductively coupled plasma mass spectrometry (ICP-MS)

13.: The interference effects of ICP-OES and ICP-MS techniques and their eliminations

14.: Comparison, evaluation and application of each measurement technics

**Summary of content - practice**:

Learning to use the most important spectroscopyc methods of the instrumental chemical analytical techniques to determine the quality and components in various samples of food, food raw materials and food ingredients.

**practices:**

1: Preparation and examination of an analytical method

2 and 3: Concentration units, and their conversion

4 and 5: Atomic mass, relative atomic mass, molecular mass

6 and 7: Performance characteristics

8: UV-Vis spectrophotometric method

9: Oxidation numbers

10 and 11: UV-Vis spectrophotometric method

12: Sample preparation for elemental analysis

13: Flame atomic absorption spectrometry

14: Inductively coupled plasma optical emission spectrometry

**Literature, handbooks**

Boss, C. B. & Fredeen, K. J., 1997. Concepts, instrumentation, and techniques in inductively coupled plasma optical emission spectrometry. Perkin Elmer. USA.

Cresser, M. S., 1994. Flame spectrometry in environmental chemical analysis. The Royal Society of Chemistry. Cambridge.

Montaser, A. & Golightly, D. W., 1987. Inductively coupled plasmas in analytical atomic spectrometry. VCH Publishers. New York.

Montaser, A. 1998. Inductively coupled plasmas mass spectrometry. VCH Publishers. New York.

Pare J.R.J. and J.M.R. Belanger, 1997. Instrumental methods in food analysis. Environment Canada, Environmental Technology Centre, Ottawa, Ontario, Canada, Elsevier, Amsterdam - Lausanne - New York - Oxford - Shannon - Tokyo.

**Management and communication, MTMEL7007A**

ECTS Credit Points: 3

28 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: oral exam

Requirements:

- for signature: Attendance is required in seminars. Students have to write an essay and give a presentation in field of management. Participation at **practice** is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Active participation is evaluated by the teacher. If a student’s behaviour or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests, students have to sit for the tests.

- for a grade: Oral exam, presentation in management field, written test in communication field.

Based on the score of the test and presentation separately, the final grade is given according to the following:

0-59 % fail (1)

60-69 % pass (2)

70-79% satisfactory (3)

80-89% good (4)

90% excellent (5)

If the average of the sum of the two parts is below 60 %, the student can take a retake test of the whole semester material once.

**Summary of content – theory**

**lectures:**

1. Meeting the discipline of management
2. Get familiar with and have an insight into the field of history of management
3. Get familiar with and have an insight into the field of decision making
4. Get familiar with and have an insight into the field of groups and teams
5. Get familiar with and have an insight into the field of management and global environment
6. Get familiar with and have an insight into the field of organizational forms
7. Get familiar with and have an insight into the field of corporate social responsibility
8. Get familiar with and have an insight into the field of nonverbal communication
9. Get familiar with and have an insight into the field of verbal communication
10. Get familiar with and have an insight into the field of elevator pith
11. Get familiar with and have an insight into the field of international communication
12. Get familiar with and have an insight into the field of executive summary
13. Get familiar with and have an insight into the field of active listening
14. Get familiar with and have an insight into the field of using social media

**Summary of content - practice**:

**practices:**

1. Acquiring basic concepts of management
2. Students will be aware of the fundamentals of history of management
3. Students will know more about decision theories, decision making techniques
4. Students now will learn basic concepts of groups and can improve team working ability
5. Students will be able to notice requirements and expectations of global environment
6. Students will learn main components and forms of the organization
7. Student will be able to identify the importance of corporate ethics and integrate CSR into organizational activity
8. Students will learn the basic knowledge of communication.
9. Students will understand the differences in intercultural communication.
10. Students will be able to make an effective elevator pitch.
11. Students will understand the rules of active listening.
12. Students will recognize the specialty of verbal communication.
13. Students will know more about the forms of nonverbal communication
14. Students will understand the importance of making a social media strategy.

**Literature, handbooks**

GRIFFIN, R. (2013): Management. 11.ed. Boston, Houghton Mifflin, Co.

DRUCKER, P. – MACIARIELO, J.A. (2008): Management. Revised edition. HarperCollins Publishers, New York.

LEHMAN, C.M. – DUFRENE, D.D. (2011): Business communication. Cengage Learning 16-th ed.54.p. ISBN 13: 978-0-324-78218-9

BOVEE, C. - THILL, J. V. (2008): Business communication today, 9th Ed. Pearson Education Inc, Prentice Hall,

SHWOM, B.G. - GUELDENZOPH SNYDER L. (2019): Business Communication: Polishing Your Professional Presence, 4th Edition, Pearson. ISBN-13: 9780134740782

ROBBINS, S. P. – JUDGE, T. A. (2013): Organizational Behavior, fifteenth edition Pearson Prentice Hall

BURNES, B. (2009): Managing Change Fifth Edition, Pearson Education Limited, Essex

Drucker, P. (2006): The effective executive. Harper Business.

Arbinger Institute (2002): Leadership and self deception, Berrett-Koehler Publishers

**The management of value creating processes in the food industry MTMEL7028A**

**Name and title of the person responsible for the subject: Dr. Buzás Ferenc PhD**

**Additional instructors involved in teaching the subject: no**

**Name and level of the program: MSC**

**Subject type: optional**

**Teaching timetable of the subject, type of examination: 2+0 K**

**Credit value of the subject: 3**

**Purpose of teaching the subject:** To familiarize the students with the strategic innovation skills of food industrial plants. The students recognize the circumstances of food innovation and value analysis of food industrial plants, prepare the value appraisal study, get acquainted with the conditions of innovaton. They have to familiarize with the basic innovation knowledges as: innovation strategy, methods, programs, and get acquainted with the measurement of innovation performances of food industries, and they have to submit a case study concerning to food value analyses.

**Content of the subject (14 weeks):**

1. The basic concept of innovation

2. The tasks of innovation management

3. Innovation strategies and methods

4. The theory of value analyses in the food industry

5. The principles of value analyses methodology

6. Financial knowledge, decision making (investment and risk analyses I.)

7. Financial knowledge, decision making (investment and risk analyses II.)

8. Innovation and science policy

9. Enterprise innovation management, incubation

10. Innovation performance, benchmarking

11. Competitiveness and innovation in European food and drink industry

12. Product and Process Innovation in the Food Industry

13. Innovation project management in the food industry

14. Value analyses study - discussion and evaluation

**Type of mid-term examination:** no

**Method of assessment (semester examination mark - report, practical grade, colloquium, examination):**

Writing exam and practical course mark (businness project in .xls format). Final note will be the average of the exam and appraisal study.

**Teaching aids:** lectures ppt

**Recommended literature:**

\* W. B. Trail – E. Pitts. (1997): Competitiveness in the food industry. Blackie Academic & Professional. London. 1-299 p. (ISBN 0751404314)

\* W. B. Trail - K.G.Grunert (1997): Product and Process Innovation in the Food Industry. Blackie Academic and Professional. London. 1-231 p. (ISBN 0751404241)

\* M.D. Ranken R.C. Kill, C.G.J. Baker (1997): Food industries Manual. Blackie Academic and Professional. London. 1-312 p. (ISBN 0751404047).

\* Grahame W. Gould (2000):Innovations in Food Processing. CRC Press.

\* Journal of Food Composition and Analysis (ISSN: 0889-1575)

**Medicinal plants and their processing, MTMEL7025A**

ECTS Credit Points: 4

14 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: Oral exam

Requirements:

- for signature: Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students may not miss more than three times during the semester.

- for a grade: Completing assignments, Giving a short presentation

**Summary of content – theory**

The aim of the course is to give information about the significance of medicinal and aromatic plants production in Hungary and in the world. Uses of medicinal plants. Classification of medicinal plants. Active ingredients of medicinal plants. Quality assurance of drugs. The production technologies of the most important herb species in Hungary. Wild collection of medicinal plants. The most important wild-harvested herbs in Hungary. Primary processing of medicinal and aromatic plants.

**lectures:**

1. Medical plant production in Hungary and in the world. Agroecological conditions of production. Drugs and their systematization.
2. Genetical background of medical and spice crops farming. Gathering of medical plants.
3. General and specific methods of production technology of medicine and aromatic plants.
4. Possibilities and practice of aromatic plant production in organic farming.
5. Processing and storing of medical and aromatic crops, extraction of active substances.
6. Qualifying of herbs.
7. Production of annual herbs: (Claviceps purpurea, Coriandrum sativum, Anethum graveolens, Carum carvi).
8. Majorana hortensis, Pimpinella anisum, Ocimum basilicum production
9. Satureja hortensis, Matricaria chamomilla, Calendula officinalis production
10. Production of biennial herbs: (Foeniculum vulgare, Digitalis lanata, Digitalis purpurea, Salvia sclarea).
11. Production of perennial herbs: (Mentha piperita, Lavandula angustifolia, Melissa officinalis).
12. Hyssopus officinalis, Thymus vulgaris, Levisticum officinale production.
13. Valeriana officinalis, Salvia officinalis production.
14. Papaver somniferum production.

**Summary of content - practice**:

The main goals are to give effective practical knowledge connecting to the production and primary processing of medicinal plant. Field trips to medicinal plant producers and to Herbária company, which is the leader in the Hungarian herbs and spices industry and trade. Visit the Research Institute for Medicinal Plants and Herbs Ltd. in Budakalász.

**practices:**

1. Medical plant production in Hungary and in the world. Agroecological conditions of production. Drugs and their systematization.
2. Genetical background of medical and spice crops farming. Gathering of medical plants.
3. General and specific methods of production technology of medicine and aromatic plants.
4. Possibilities and practice of aromatic plant production in organic farming.
5. Processing and storing of medical and aromatic crops, extraction of active substances.
6. Qualifying of herbs.
7. Production of annual herbs: (Claviceps purpurea, Coriandrum sativum, Anethum graveolens, Carum carvi).
8. Majorana hortensis, Pimpinella anisum, Ocimum basilicum production
9. Satureja hortensis, Matricaria chamomilla, Calendula officinalis production
10. Production of biennial herbs: (Foeniculum vulgare, Digitalis lanata, Digitalis purpurea, Salvia sclarea).
11. Production of perennial herbs: (Mentha piperita, Lavandula angustifolia, Melissa officinalis).
12. Hyssopus officinalis, Thymus vulgaris, Levisticum officinale production.
13. Valeriana officinalis, Salvia officinalis production.
14. Papaver somniferum production.

**Literature, handbooks**

Hornok, L. (1992) Cultivation and Processing of Medicinal Plants. John Wiley & Sons Ltd, Baffins Lane, Chicester, UK 338. p. ISBN 0-471-92383-4

WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants. World Health Organization Geneva (2003)

**Microbiological aspects of food quality and safety, MTMEL7011A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: written exam

Requirements:- for signature: Completing presentations, exercises

Giving presentation

- for a grade: written exam

**Summary of content – theory**

The aim of the subject is to provide knowledge about the foodborne pathogens and foodborne diseases. The microbiota of the different food products, and their characteristic microbiota, focusing on the microbes causing spoilage and foodborne pathogens.

Basic skills and knowledge during the practice enables student to plan and do food microbiological examinations for quality detection.

**lectures:**

1. History of Microorganisms in Food. Role, and Significance of Microorganisms in Foods. Microorganisms and food materials.
2. Introduction to Foodborne Pathogens. Faecal-oral infection route of foodborne pathogens. The pathogenesis of foodborne diseases.
3. Food Poisoning Caused by Gram-Positive Spore-forming.
4. *Staphylococcus aureus* and staphylococcal gastroenteritis. Listeria monocytogenes and foodborne listeriosis.
5. *Salmonella* genus and foodborne gastroenteritis caused by *Salmonella*.
6. *Escherichia coli* and foodborne gastroenteritis caused by *Escherichia coli*.
7. *Shigella* genus and shigellosis. *Yersinia* genus and yersiniosis. *Vibrio* genus and vibriosis. *Campylobacter* genus and campylobacteriosis.
8. Mycotoxigenic fungi and mycotoxins.
9. Foodborne Viruses and parasites.
10. Microorganisms in fresh meats and poultry. Microorganisms in processed meats and seafoods.
11. Microorganisms in milk, fermentation, and fermented and nonfermented dairy products.
12. Microorganisms in vegetable and fruit and in their products. Microorganisms in soft drinks and bottled waters.
13. Microorganisms in cereals and bakery products, sugars, candies.
14. Microorganisms in spices, oil rich seeds, coffee, tea, herbs. Microorganisms in cans and RDE, RDU products.

**Summary of content - practice**:

How to work in the microbiology lab; how to gain extra information about the subject of investigation; microbiology calculations;

**practices:**

1. Equipment, culture media, sterilization
2. Sampling for microbiological analysis
3. Plating methods and quantification of microorganisms
4. Microbiology of fish and seafood
5. Detection of *S. aureus*; Gram staining
6. Contamination of eggs, Enterobacteriaceae count
7. Microbiology of plant products, measurement of water activity
8. Microbiology of frozen food and pastries, spore-forming bacteria
9. Methylene blue reduction test and detection of *Escherichia coli* from raw milk
10. Sensitivity of microbes against antimicrobial substances and environmental factors
11. Detection and identification of *Salmonella*
12. Detection and identification of *Listeria monocytogenes* and other *Listeria* species
13. Endospore staining
14. Detection and identification of *Campylobacter* ssp.

**Literature, handbooks**

Jay, J. M., Loessner, M. J., Golden, D. A. (2005): Modern Food Microbiology. ISBN 978-0-387-23413-7

Adams, M. R., Moss M. O. (2008): Food Microbiology. The Royal Society of Chemistry. ISBN 978-0-85404-284-5

Karaffa E., Peles F (2014): Microbiological Aspects of Food Quality And Safety. Debreceni Egyetem, Debrecen.

Madigan, M. T, Martinko, J. M., Bender K., Buckley, D., Stahl, D (2015): Brock Biology of Microorganisms, Benjamin Cumming, 14th edition 1030 oldal, ISBN 978-1-292-01831-7

**Molecular background of animal product quality, MTMEL7035A**

ECTS Credit Points: 3

14 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: oral exam

Requirements:

- for signature: Attendance at lectures is recommended, but not compulsory.

- for a grade: oral exam

**Summary of content – theory**

The main part of the lecture describes the molecular markers responsible for product quality expected by consumers. The effect of different markers on food quality parameters will be discussed. Research studies will be used to show the different effects of genetic markers, genes and SNPs. Students completing the course will have a wide knowledge on the significance of genetic markers responsible for animal product traits and characteristics.

**lectures:**

1. Animal breeding and species specialty, animal production

2. Breed means a certain set of quality parameters

3. Meat quality

4. Genetic background of carcass traits

5. Genetic markers of meat tenderness, pH and colour

6. Markers of meat technological quality and organoleptic traits

7. Candidate DNA regions of marbling, carcass fat, fatty acid composition of animal product

8. Genetic markers responsible for milk quality I.

9. Genetic markers determining the quality of wool and egg

**Literature, handbooks**

Arinus F. W. te Pas et al. (2004): MuscleDevelopment of LivestockAnimals: Physiology, Genetics and MeatQuality. CABI. 1-432.

Nollet L. M. L., Toldra F. (2006): Advanced Technologies forMeatProcessing. CRC Press. 1-483.

Womack J. (2012): BovineGenomics. Wiley-Blackwell. 1-284.

**Molecular biology methods for food authentication, MTMEL7034A**

ECTS Credit Points: 3

14 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Laboratory report, Participation in lectures according to Rules and Regulations of UD

- for a grade: written exam

**Name and title of the person responsible for the subject:** Dr. Czeglédi Levente professor

**Additional instructors involved in teaching the subject:**

**Name and level of the program:** Food Safety and Quality MSc.

**Subject type:** optional

**Teaching timetable of the subject, type of examination:** 1+1 K

**Credit value of the subject:** 3

**Purpose of teaching the subject:** The students of the course will have a complex knowledge that focuses on the proof of origin that defines consumer protection. Students will learn the basics of molecular genetics, will be able to interpret species identification methods based on DNA tests, protein / peptide analysis, and fatty acid composition methods. Get to know the current limitations and the potential of different approaches to prove the origin of animal derived food and food products.

**Content of the subject (14 weeks):**

1. Basics of molecular genetics
2. Genetic inheritance, genetic structure of the population
3. The occurrence, importance and types of mutations
4. The genome
5. Biotechnics - Biotechnology
6. Methods to detect the species in animal derived foodstuffs
7. Genetic Methods I.
8. Genetic Methods II.
9. Quantitative genetic methods
10. Authentication techniques based on DNA conformation and melting point
11. Practical solutions with DNA-based food tests
12. Proteomics and protein assay methods for species identification
13. Fats, fatty acids, fatty accid composition of animal products
14. Authentication by Fatty Acid Analysis

**Type of mid-term examination: -**

**Method of assessment (semester examination mark - report, practical grade, colloquium, examination):** written exam

**Teaching aids:** ppt files

**Recommended literature:**

Safdara M., Junejo Y. (2016): The development of a hexaplex-conventional PCR for identification of six animal and plant species in foodstuffs. Food Chemistry. 192. 745-749.

Kitpipit T., Sittichan K., Thanakiatkrai P. (2014): Direct-multiplex PCR assay for meat species identification in food products. Food Chemistry. 163. 77-82.

Montowska M., Pospiech E. (2013): Species-specific expression of various proteins in meat tissue: Proteomic analysis of raw and cooked meat and meat products made from beef, pork and selected poultry species. Food Chemistry 136. 1461–1469.

Gaspardo B., Lavrencic A., Levart A., Del Zotto S., Stefanon B. (2010): Use of milk fatty acids composition to discriminate area of origin of bulk milk. Dairy Sci. 93. 3417-26.

Indrasti D., Man Y. B. C., Mustafa S., Hashim D. M. (2010): Lard detection based on fatty acids profile using comprehensive gas chromatography hyphenated with time-of-flight mass spectrometry. Food Chemistry, 122. 4. 1273-1277.

**Nutritional genetics and genomics, MTMEL7037A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: Written and oral exam

Requirements:

- for signature: Submission of 2 essays

Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the lecturer. Active participation is evaluated by the teacher.

- for a grade: Written and oral exam

**Summary of content – theory**

• Students will understand the correlation between genomes and environmental factors that facilitate every vital phenomena, and nutrition will be regarded as one of the most important environmental factors, influencing the general health condition of humans.

• Students will be acquainted with the main trends nutritional genetic and genomic trends regarding the innovative food development with respect to personalized preventive and /or therapeutic nutrition.

**lectures:**

1. Nutritional genetics and genomics. Concepts, research tools and expectations.

2. Epigenetics. Molecular targets for diet and chronic disease prevention. Diet influenced chromatin modifications and expression of chemopreventive genes.

3-4. Nuclear receptors and signal transduction pathways regulating gene expression.

5. Nuclear receptors and the control of gene expression by fatty acids.

6. PPARs regulated cell differentiation processes.

7. Amino acid availability and gene expression regulation.

8. Transcriptional regulation of hepatic genes by insulin and glucose.

9. PPARs in atherosclerosis.

10. PPAR implication in diabetes and metabolic syndrome.

11. Regulation of lipogenic genes in obesity.

12. Nutrition and inflammatory response.

13. Genetic polymorphism, nutrition and hypertension.

14. Genetic polymorphism, nutrition and cancer.

**Summary of content - practice**:

Student will carry out some experiments in order to study the influence of nutrition on animal experimental models. They will learn about the experiments meant to detect the induced mutagenic effect.

**practices:**

1-2. *Drosophila melanogaster* as a nutritional genetic research model system.

3-4. Studying plant extracts chromatin organization modifier effects

5-6. Evaluation of mutagenic effect using somatic mutation and recombination test.

7-8. Evaluation of Keap1/Nrf2/ARE mediated xenobiotic response induced by plant extracts.

9-10. Animal models for studying the metabolic syndrome.

11-12. Elaboration of a nutritional genetic and genomic research project to study a food prototype.

13-14. Product concept presentation and evaluation.

**Literature, handbooks**

Aggarwal, B.B., Heber, D. (2014). Immunonutrition: Interactions of Diet, Genetics, and Inflammation. CRC Press, ISBN: 9781466503854.

Bidlack, WR, Rodrigez, RL. (2012). Nutritional Genomics. The impact of dietary regulation of gene function on human disease. CRC Press, Taylor & Francis Group, Boca Raton, London, New York, ISBN: 978-1-4398-4452-6.

Brigelius-Flohé R and Joost H-G. (2006). Nutritional Genomics. Impact on Health and Disease. Whiley-VCH Verlag GmbH&Co. KGaA. ISBN-10: 3-527-31294-3

Graham, G., Kesten, D., Scherwitz, L. (2011). Pottenger's Prophecy: How Food Resets Genes for Wellness or Illness. ISBN: 978-1-935052.

Kohlmeier, M. (2012). Nutrigenetics Applying the Science of Personal Nutrition. Academic Press. ISBN: 978-0-12-385900-6

Lanham-New, S.A., Macdonald, I.A., Roche, H.M. (2010). Nutrition and Metabolism, 2nd Edition. Wiley-Blackwell. ISBN: 978-1-4051-6808-3

Shanahan, C. and Shanahan, L. (2008). Deep Nutrition: Why Your Genes Need Traditional Food. ISBN-10: 0-615-22838-0.

PUBMED database /Books:

- Pagon RA, Adam MP, Ardinger HH, et al., editors. (1993-2014). GeneReviews® [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2014.

- Making Sense of Your Genes: A Guide to Genetic Counselling. National Society of Genetic Counselors; Genetic Alliance. Washington (DC): Genetic Alliance; 2008.

- Integrating Large-Scale Genomic Information into Clinical Practice: Workshop Summary. Institute of Medicine (US). Washington (DC): National Academies Press (US); 2012.

- Benzie I.F.F. and Wachtel-Galor, S. (2011). Herbal Medicine, 2nd edition. CRC Press; ISBN-13: 978-1-4398-0713-2

**Nutritional Sciences,** **MTMEL7009A**

ECTS Credit Points: 3

28 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: colloquium

Requirements:

- for signature: Giving presentation (10 minutes)

- for a grade: Written exam (minimum marks when percentage is 60%)

**Summary of content – theory**

Acquisition of the chemical bases of the processes that determine the production and quality assurance of foods and raw materials, their scientific foundation, and the understanding of the chemical bases. Developing skills to accommodate new knowledge.

Education of selected general and inorganic chemical knowledge, grounding of chemical studies, and the foundation of related primer and subject areas.

**lectures:**

1st week: Content of subject “Nutritional Sciences”, organs and their functions of the gastrointestinal tract

2nd week: Nutritional assessment and dietary planning. Dietary Reference Intakes (DRIs), Estimated Average Requirements (EARs), Recommended Dietary Allowances (RDAs), Adequate Intake (AI), Tolerable Upper Intake Levels (ULs), Safe Maximal Intakes, Energy Intake

3rd week: Chemical, biological and physiological aspects of nutrition. Acid-base equilibrium, passive and active transports, HCl synthesis in the stomach wall cells

4th week: Bio-catalysers. Role and structure of enzymes. Factors influencing enzyme activity: activators, inhibitors and destructors, temperature, pH-values, enzyme and substrate concentrations

5th week: Carbohydrates: structure and role of mono-, di- and oligosaccharides; functions of polysaccharides of plants and animals/human beings

6th week: Structure of protein building amino acids. Definition of non-essential, essential and conditionally essential amino acids. Amid and peptide bonds. Protein structures and shapes, way of protein synthesis and hydrolysis. Complete and incomplete proteins, protein complementation, protein quality

7th week: Structure and functions of gastro-internal hormones. Lipoids and lipids. Neutral lipids and phospholipids. Biosynthesis and metabolism of fatty acids and lipids. Essential and conditionally essential fatty acids, omega-3 fatty acids

8th week: Energy metabolism. Synthesis of ATP molecules: Reactions and energetic results of citric acid cycle (Szent-Györgyi - Krebs cycle) and the sequential oxidative phosphorylation processes

9th week: Energy balances and body weight regulation. Basal metabolic rate (BMR), basal energy expenditure (BEE), resting metabolic rate (RMR), resting energy expenditure (REE), standard metabolic rate (SMR)

10th week: Fat soluble vitamins (The “DEKA” vitamins) – their structure, chemical composition, physiological role, symptoms of hypo- and avitaminosis, reason and symptoms of hypervitaminosis. Night blindness, rickets. Natural sources of A-, D-, E- and K-vitamins

11th week: Water soluble vitamins – their structure, chemical composition, physiological role, symptoms of hypo- and avitaminosis. RDA values

12th week: The major mineral nutrient elements of foods – C, O, H, N, P, K, Ca, Mg, S, Na. Sources and role of the macroelements. Main function of water in the human body. Aging and water content of human body

13th week: The minor mineral nutrient elements of foods – Fe, Mn, Zn, Se, Ni, Cr, I, F. Sources and role of the microelements. Water hardness: definition, sources, determination methods, optimum physiological level, water softening methods

14th week: Human life cycle nutrition; babies, young children, teenagers, adult persons and seniors. Functional nutrition – definition, importance, possibilities

**Literature, handbooks**

***Compulsory literature:***

McGuire, M. – Beerman, K. A. (2013): Nutritional Sciences – From Fundamentals to food. Wadsworth Cengage Learning, Australia • Brazil • Japan • Korea • Mexico • Singapore • Spain • United Kingdom • United States. ISBN-13: 978-0-8400-5820-1

***Optional literature:***

Ross, A.C. – Caballero, B. – Cousins, R.J. – Tucker, K.L. – Ziegler, T.R. (2014): Modern Nutrition in Health and Disease. Wolters Kluwer Health/Lippincott Williams & Wilkins, Philadelphia, USA. ISBN-13: 978-1605474618

**Packaging technology, MTMEL7030A**

ECTS Credit Points: 3

28 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Written and oral exam

- for a grade: 2 essays on given topic

**Summary of content – theory**

The types of packaging materials (textiles, wood, metal, glass, paper and plastic), pairing possibilities knowledge. The quality of the packaging and reliability. Packaging machines and devices, packaging environmental impact of materials, re-processability. Food and packaging interaction (diffusion and migration). The food commodity marking (labelling). Mandatory and voluntary labelling (use of information and advertising).

**lectures:**

1. Packing elements (basic concepts, aims and tasks of the pack)
2. Packaging Training (consumer and multipack packaging)
3. Paper (sachets, bags, sacks, carton boxes)
4. Metal packaging products (coated and zinc plated steel plate, aluminum foil, trays, tubes and barrels)
5. plastics-based packaging products (hermoplastics and hardening plastics films,

plates, boxes, hollow objects)

1. Glass containers (narrow and wide-mouth jars and closing their methods)
2. Wood packing materials
3. Textiles packing materials
4. Combined packaging supplies
5. Vacuum and modified atmosphere packaging
6. Dangerous goods packaging
7. Cargo handling markings, signs
8. Packaging and the environment protection
9. The food and packaging materials interaction

**Literature, handbooks**

Richard Coles, Derek McDowell, Mark J. Kirwan: 2003. Food packaging technology. CRC Press, London. 346 p. ISBN 9780849397882.

Dong Sun Lee, Kit L. Yam, Luciano Piergiovanni: 2008. Food Packaging Science and Technology. CRC Press, London. 656 p. ISBN 9780824727796.

Gordon L Robertson: 2013. Food Packaging Principles and Practice. CRC Press, London. 686 p. ISBN 9781439862421.

**Proteomics in food production, MTMEL7038A**

ECTS Credit Points: 3

14 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Participation in lectures according to Rules and Regulations of UD, laboratory report

- for a grade: written exam

**Summary of content – theory**

Successful completion of the course provides the knowledge, which is needed to understand the quality of food affected by the proteom. The theoretical knowledge of a number of methodologies and procedures taught during the course gives the opportunity to design proteomic examinations, search for biomarkers and evaluate them professionally. Absolved students are enriched by a complex vision of proteins that have a significant effect on raw and processed food.

**lectures:**

1. Proteomics Methods I.
2. Proteomics Methods II.
3. Proteomics of meat and meat products I.
4. Proteomics of meat and meat products II.
5. Proteomics of eggs
6. Proteomics of milk and dairy products
7. Proteomics of beer
8. Proteomics of wine
9. Cereals and proteomics
10. Fruits and their expressed proteins
11. Vegetable proteins from the food industry
12. Proteomics of fish as food
13. Mass spectrometry in food analysis
14. Chromatography, immunology, amino acid analysis in food analysis

**Summary of content - practice**:

The general aim of the practise is to provide students the basics of gel-based proteomic methods, to perform laboratory analyses and evaluate the results of food samples. The acquired knowledge gives an insight into the critical points of the protein expression platform.

**practices:**

1. General laboratory knowledge, solution preparation
2. Protein isolation from meat
3. Protein isolation from meat
4. Protein concentration determination
5. Further purification of isolated protein
6. Depletion of highly abundant proteins
7. Fractionation of Proteins
8. Fractionation of Proteins
9. Isoelectric focusing
10. Isoelectric focusing
11. Polyacrylamide Gel Electrophoresis (2D)
12. Polyacrylamide Gel Electrophoresis (2D)
13. Polyacrylamide Gel Electrophoresis (1D)
14. Polyacrylamide Gel Electrophoresis (1D)

**Literature, handbooks**

Posch A. ed (2008): 2D PAGE: Sample Preparation and Fractionation. Volume 1. Humana Press. 1-459.

Cutillas P.R.,Timms J.F. (2010): LC-MS/MS in Proteomics. Volume 658. Humana press. 1-330.

Fidel T.,Nollet L. M. L. (eds) (2013): Proteomics in foods. Springer. 1-710.

**Quality and safety of food technologies (HACCP in practice), MTMEL7004A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Successful test (60%) and participation in practices

- for a grade: Test and individual project task

**Summary of content – theory**

The main aim of the lectures is to know the hygiene requirements related to plant and animal origin food production, the structure of HACCP plan and the methodology of product description, manufacturing formula, hazard identification, hazard analysis, flow diagram preparation and corrective action determination. Until the end of the semester, student will be able to identify the physical, chemical and microbiological hazard in plant and animal origin food production, and they will be able to prepare a HACCP plan.

**lectures:**

1. 852/2004/EC and 853/2004/EC regulations
2. Methodology of HACCP plan preparation
3. Methodology of hazard analysis preparation
4. Hazards in the production of bakery products
5. Hazards in the production of confectionary products
6. Regulations of the production of milk and dairy products
7. Regulation of the production of meat and meat products
8. Hazard analysis of heat treated plant origin products
9. Regulation of poultry and poultry meat products
10. Hazard analysis of canned and quick-frozen plant origin food
11. Regulations of egg and egg products
12. Regulations of fish and fishery products
13. Hazard analysis of alcoholic and non-alcoholic beverages
14. Test

**Summary of content - practice**:

The main aim of the practices is to increase the knowledge of HACCP plan and hazard analysis. For this purpose, the preparation of HACCP plans will be carried out for specific foodstuffs, and students will make an individual project task about a chosen food.

**practices:**

1. Hazards in the production of milk and dairy products
2. Preparation of flow diagram
3. Preparation of product description
4. Preparation of hazard analysis and determination of CCPs
5. Determination of monitoring procedures and corrective actions
6. Hazard analysis of a dairy product
7. Hazards in the production of meat products
8. Hazard analysis of a pork meat product
9. Hazard analysis of a cured poultry product
10. Hazard analysis of a quick-frozen poultry product
11. Hazard analysis of an egg product
12. Hazard analysis of a canned fish product
13. Group presentation of the project tasks
14. Group presentation of the project tasks

**Literature, handbooks**

2016/C 278/01 EU Commission notice on the implementation of food safety management systems covering prerequisite programs (PRPs) and procedures based on the HACCP principles, including the facilitation/flexibility of the implementation in certain food businesses

852/2004/EC regulation (2009): on the hygiene of foodstuffs

853/2004/EC regulation (2017): laying down specific hygiene rules for food of animal origin

Lelieved, H., Holah, J., Gabric, D.: (2016): Handbook of Hygiene Control in the Food Industry. ISBN: 978-0-08-100197

Codex Alimentarius Commission: Food hygiene. Basic texts. (http://www.fao.org/docrep/012/a1552e/a1552e00.pdf)

**Quality control and quality management, MTMEL7012A**

ECTS Credit Points: 4

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Completing exercises. Attendance at the lectures is recommended, but not compulsory. Attendance at the practices is compulsory. Students may not miss more than three practices during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. In case of further absences, a medical certificate needs to be presented.

- for a grade: written test on the basis of the lecture and the practical course

**Summary of content – theory**

The course covers the concept and importance of quality, the historical background, the concept of quality assurance. Development of quality management, evolvement of total quality management from the quality checking of the manufactures. Quality tools and techniques are also discussed and are the main topics of the practice. LEAN as main goal and practice with its tools in industry is also presented. Audit of the quality control systems and the accreditation techniques as well as quality assurance in laboratory are covered.

**lectures:**

1. Legal aspects of quality management. Warranty, product liability, certification of product safety, compliance. Contracts.
2. The concept of quality, process elements of quality, external and internal factors of quality. Crosby’s quality absolutes. Juran’s quality planning pathway.
3. Edward Deming’s philosophy. Quality management plan (PDCA cycle)
4. Economic aspects of quality management. Cost of quality (Feigenbaum), Process-cost. Quality controlling.
5. The Japanese philosophy: kaizen. KAIZEN tools.
6. Total quality management. Kaizen in TQM in ISO 9000.
7. Process-orientation and process control
8. Standardization, system management standards. Elements of quality management.
9. Project-management.
10. LEAN. LEAN tools: six sigmas, DMAIC, value stream mapping
11. Good Laboratory Practice
12. Accreditation techniques.
13. Metrology. Measurement and control of measurement by the ISO 9000 standards.
14. Calibration and validation. Characteristics and formality of quality assurance of analytics.

**practices:**

1. Root cause analysis -5 Why method, Flowcharting
2. Root cause analysis – Fishbone diagram
3. Root cause analysis – Affinity diagram
4. Check sheet
5. Histogram
6. Pareto diagram and ABC diagram
7. Gantt diagram
8. Scatter plot
9. Control charts
10. Force field analysis
11. Break-even analysis
12. Matrix of competence
13. FMEA
14. 5S method and self-test

**Literature, handbooks**

Pojasek: Lean, Six Sigma, and the Systems Approach: Management Initiatives for Process Improvement Environmental Quality Management, 13 (2), 2003.

Soković et al. (2009): Basic Quality Tools in Continuous Improvement Process Journal of Mechanical Engineering 55, 5

Pusztahelyi, T. (2019) Practical exercises for the Course “Quality control, quality management” handout. EFOP-3.4.3-16-2016-00021

**Quality control of biological bases, MTMEL7026A**

ECTS Credit Points: 3

28 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Completing assignments / exercises, submitting essay, giving presentation

- for a grade: written exam

**Summary of content – theory**

Students recognize the importance of the biological resources of crop production, the system of qualification, the genotype and sowing seed production of scientific methods and practical aspects. They will be able to learn the curriculum through the arable crop varieties / hybrid portfolio of multi-disciplinary approach to the classification of the genotypes habitat and species-specific adaptation and the practical issues of the seed used to treat high levels.

Students are able to recognise the importance of different breeding systems in case of different utilization types. They will know what kind of testing methods are used by the different species, and they will know the most important features in case of the different type of animals.

**lectures:**

1. The concept of biological resources, significance and role of crop production
2. The specific multidisciplinary role of the genotype and the sowing seed in the crop production
3. The varieties testing’s process, system, elementary and special functions of the sowing seed production
4. The varieties and habitat-specific technologies significance of the biological resources of qualification
5. Importance of the traditional and GM plants and significance of their production advantages, disadvantages
6. The role of genotype in cereal oil, leeguminous and other other plants’s crop production.
7. The role of the sowing seed in cereal oil, leeguminous and other other plants’s crop production.
8. Breeding methods during the production of the breeding animals
9. Demonstration of the importance of purebred breeding and hybrid production in the world by species
10. Order of control of breeds
11. Methods of performance testing in pig breeding
12. Performance testing methods for cattle breeding
13. Performance testing methods in small ruminant breeding
14. Performance testing methods for poultry farming

**practices:**

1. The concept of biological resources, significance and role of crop production
2. The specific multidisciplinary role of the genotype and the sowing seed in the crop production
3. The varieties testing’s process, system, elementary and special functions of the sowing seed production
4. The varieties and habitat-specific technologies significance of the biological resources of qualification
5. Importance of the traditional and GM plants and significance of their production advantages, disadvantages
6. The role of genotype in cereal oil, leeguminous and other other plants’s crop production.
7. The role of the sowing seed in cereal oil, leeguminous and other other plants’s crop production.
8. Breeding methods during the production of the breeding animals
9. Demonstration of the importance of purebred breeding and hybrid production by species in the world
10. Order of control of breeds
11. Methods of performance testing in pig breeding
12. Performance testing methods for cattle breeding
13. Performance testing methods in small ruminant breeding
14. Performance testing methods for poultry farming

**Literature, handbooks**

1. Acquaah, G. (2001): Principles of crop production. Theory, Techniques and Technology. Pearson Prentice Hall. ISBN 0-13-114556-8

**Quality evaluation of food protein, MTMEL7029A**

ECTS Credit Points: 3

28 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: colloquium

Requirements:

- for signature: Completing assignments / exercises, giving presentation. Attendance at lectures is recommended, but not compulsory. Students must hand in a presentation once during the semester.

- for a grade: written exam

**Summary of content – theory**

Structure and properties of proteins, description of technics and methods used in protein determination.

**lectures:**

1. Nitrogen requirements of plants.
2. Chemical structure of proteins.
3. Methods to determine amino acids.
4. Methods for the grading food proteins.
5. Chemical methods.
6. Enzymatic methods.
7. Microbiological methods.
8. Utilization of proteins.
9. Degradability of proteins.
10. Determining proteins in swine forages, in vivo, in vitro methods
11. Determining proteins in swine forages, in vivo, in vitro methods
12. Isolation of proteins.
13. Purification of proteins.
14. Sequencing techniques.

**Literature, handbooks**

Daniel Chasman: Protein Structure: Determination, Analysis, and Applications for Drug Discovery (2003)

**Quality management systems and audit in the food chain, MTMEL7016A**

ECTS Credit Points: 4

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Participating in the exercises, completing practical exercises, submitting practical essays, giving presentation. The course ends in a mid-semester grade based on the result of the mid-year written exams. The minimum requirement for both mid-term and end-term written exams is 60%.

Result and grade:

0-59%: fail (1)

60-69%: pass (2)

70-79%: satisfactory (3)

80-89%: good (4)

90-100%: excellent (5)

If the result of the written exams is below 60%, it is necessary to rewrite that.

- for a grade: written exam (if the result of the mid-year written exams is less than 60%)

**Summary of content – theory**

The aim of the subject is the introduction of standards, furthermore, the development, operation and certification of the quality, environmental and food safety systems.

**lectures:**

1. Introduction. Definitions. Evolution of quality management
2. GMP, GHP, GAP
3. GLOBALGAP
4. HACCP
5. ISO 9001, ISO 14001
6. ISO 22000. GFSI, FSSC 22000
7. BRC Global Standard for Food Safety
8. IFS Food Standard
9. Auditing of management systems

**Summary of content - practice**:

development, operation and certification of the quality, environmental and food safety systems.

**practices:**

1. Application and audit of ISO 9001:2015 standard
2. Application and audit of ISO 9001:2015 standard
3. Application and audit of ISO 22000:2018 standard
4. Application and audit of ISO 22000:2018 standard
5. Application and audit of BRC Global Standard for Food Safety
6. Application and audit of BRC Global Standard for Food Safety
7. Application and audit of IFS Food standard
8. Application and audit of IFS Food standard
9. Application and audit of GLOBALGAP IFA standard

**Literature, handbooks**

Peles, F. – Juhász, Cs. (2014): Quality assurance. University lecture notes. University of Debrecen. /ISBN 978-963-473-656-1/ TÁMOP 4.1.2.A/1-11/1-2011-0009. 177p.

Vasconcellos, J.A. (2004): Quality Assurance for the Food Industry. A Practical Approach. CRC Press. 448 p.

Jacxsens, L. – Devlieghere, F. – Uyttendaele, M. (2009): Quality Management Systems in the Food Industry. Ghent University. 153p.

**Radiology in food industry, MTMEL7019A**

ECTS Credit Points: 3

28 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written or oral exam

Requirements:

- for signature: taking part in 60% of practice

- for a grade: Written test

**Summary of content – theory**

The purpose of the course is to know the sources, measurement and effects of radioactive contamination of foodstuffs. Students will learn about the types of ionizing radiation, the occurrence, measurement and application of radioactive isotopes. They learn about the possibilities of handling foods with ionizing radiation.

**lectures:**

1. History of radioactivity, basic concepts
2. Radioactive Isotopes, Radiations, Radioactive Decay, Legislation
3. Decomposition Forms, Radiations, Decomposition series, Artificial Radioactivity, Neutron Radiation, Other Particles in Radiations, Fission (Induced), Spontaneous Fission
4. Measurement of radioactive radiation, Interaction of radiation with the material, Detectors, Measuring devices and their characteristics, Dosimetry of ionizing radiations
5. Dose and Units, Accepted Dose, Equivalent, Effective Dose, Dose Measurement
6. Chemical and biological and health effects of ionizing radiation, Physical and chemical effects of radiation, Biological effects of radiation, Cellular effects of radiation, Radiation damage of tissues, organs and human organism, Deterministic and stochastic effects of radiations
7. Radiation Protection, Limit Values, Activity of Foods in a Nuclear Emergency, Treatment of Radioactive Materials
8. Radiological aspects of medical interventions, Diagnostics, Screening Techniques, Radioisotope Procedures, Therapy, Special Radiation Protection Issues in Medical Applications, Special Events, Emergency Management
9. Emergency, Accident Levels for Population, Natural Radiations, Radiation, Cosmogen Radionuclides, Earthquake Radiations, Limits and Regulations on Natural Radiations, Artificial Radiations, Radiation Detection
10. Nuclear Accidents, Three Mile Island Accident, Chernobyl, Tokai Mura, Fukushima, Weapons Accidents
11. The role of nuclear energy in power generation, Nuclear power plants and their environmental impacts, Short history of nuclear power plants, Principle of operation, Nuclear power plants, Nuclear power plants eradication
12. Investigating the radiation of foodstuffs
13. Treatment of Foods by Ionizing Radiation
14. Neutron activation analysis

**practices:**

1. 1-2. Visit: gamma sterilization
2. 2-3. Business Visit: Cyclotron
3. 3-6. Radiation measurement practice
4. 6-14. Evaluation of nuclear accidents and presentations

**Literature, handbooks**

Handbook of Radioactivity Analysis Edited by:Michael F. L'Annunziata ISBN: 978-0-12-436255-0 1998 Elsevier Inc

Environmental Radioactivity and Emergency Preparedness Mats Isaksson, Christopher L. Raaf 2016 by CRC Press ISBN 9781482244649

Radioactivity Transfer in Environment and Food Authors: Vosniakos, Fokion K ISBN 978-3-642-28740-4 Springer

Radioactivity: Introduction and History 1st Edition Authors: Michael L'Annunziata Michael L'Annunziata eBook ISBN: 9780080548883 Hardcover ISBN: 9780444527158 Imprint: Elsevier Science

**Regulation of food production, quality and safety, MTMEL7013A**

ECTS Credit Points: 3

42 hour(s) lecture and 0 hour(s) seminar per semester

Type of exam: written exam

Requirements:- for signature: Attendance at lectures is recommended, but not compulsory. Completing assignments / exercises, submitting essay, giving presentation

- for a grade: Completing a test

**Summary of content – theory**

In this course, students will get some basic legal knowledge. They will get an overview of the past and present of the legal regulation on food law. The students will be able to understand and use the special legal term of food law. The students will gain an overview of the legal concepts relevant to the control and administration of the food industry. The students will be able to understand the purposes and background of food law, both domestic and EU.

**lectures:**

1. Prelude, basic concepts of law, hierarchy of the legal system, legislators.
2. The history of legal regulation on food production
3. The European Union I. – a historical and institutional overview
4. The European Union II. - The legal system of the European Union, the primacy of European Union law
5. The general principles and requirements of EU food law - Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down, establishing the European Food Safety Authority and laying down procedures in matters of food safety
6. The European Food Safety Authority (EFSA)
7. RASFF - Food and Feed Safety Alerts
8. EU 852/2004 -: Regulation on Hygiene of food stuffs
9. The HACCP system
10. The regulation No 2160/2003 of the European Parliament and of the Council on the control of salmonella and other specified food-borne zoonotic agents
11. United States Food Laws and Regulations.
12. The Hungarian national legal regulation on food safety.
13. National Food Chain Safety Office.
14. The Fundamentals of Labour Law in Hungary.

**Literature, handbooks**

**Bernd van der Meulen, Irene Scholten-Verheijen, Theo Appelhof, and Ronald van den Heuvel: Roadmap to EU Food Law, Eleven International Publishing, 2011. ISBN 978‐94‐90947‐26‐2**

**Bernd van der MEULEN: EU Food Law Handbook, Wageningen Academic Publishers Books, 2012. ISBN 978-90-8686-246-7**

**Bernd M.J. van der Meulen: Private food law. Governing food chains through contract law, self-regulation, private standards, audits and certification schemes. European Institute for Food Law series, Volume 6, Wageningen Academic Publishers Books, 2011. ISBN: 978-90-8686-176-7**

**Jens Hartig Danielsen: EU Agricultural Law, Wolters Kluwer, Holland, 2013. ISBN: 9789041132802**

**Rheology in food testing, MTMEL7022A**

ECTS Credit Points: 3

14 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice** is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader.

Requirements to get a grade:

The minimum requirement for the test is 60%.

0-59 % fail (1)

60-69 % pass (2)

70-79 % satisfactory (3)

80-89 % good (4)

90-100 % excellent (5)

- for a grade: Completing assignments, Giving presentation, Take an exam

**Summary of content – theory**

The aim of this subject is to present the basic elements of rheology. It presents the aims of rheology and the general properties of elastic and viscous deformation. It presents the connections of stress and deformation in details and the connecting principles, the basic models of different rheological systems (Kelvin, Maxwell and other). The measurement of rheological properties – rheometry. The general rheometric methods (capillary viscometers, rotational viscometers, rheometers, texture analysis). At the end, selected food groups are presented by their rheological behaviour and their special rheometric methods are also discussed.

**lectures:**

1. Aim of rheology
2. The elastic and viscous deformation.
3. Connections of stress and deformation. Superposition principles
4. Elastic deformations and modulus. Shearing stress and viscosity
5. Rheological models (Kelvin, Maxwell, Burgers model)
6. Rheometry: Capillary viscometers, Rotational viscometers, Rheometers
7. Force measurement methods
8. Distance, time and ratio measurements
9. Texture analysis – aims, types
10. Exam

**Summary of content - practice**:

The general aim of the practice is to enable students to acquire knowledge in the science of rheology. Learn the practical use of rheology by measuring rheological properties by performing different rheometric measurements.

**practices:**

1. Safety education and accident prevention
2. Demonstration the tools using in the practice
3. Rheological methods in cereal analysis
4. Farinograph
5. Hagberg falling number
6. Viscosity
7. Calculation practice
8. Rheological methods in fruit analysis
9. Texture analyser
10. Exam

**Literature, handbooks**

Howard A. Barnes (2000): A Handbook of Elementary Rheology. University of Wales, Institute of Non-Newtonian Fluid Mechanics, 200. p. ISBN 0953803201

Malcolm C. Bourne (2002): Food Texture and Viscosity: Concept and Measurement. Second Edition. Academic Press, UK, 427. p. ISBN-10: 0121190625

Sipos P. (2014): Rheology in food analysis. Debreceni Egyetem, Debrecen, egyetemi jegyzet, 57. p.

**Separation techniques, MTMEL7003A**

ECTS Credit Points: 5

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: 80% participation in the lectures and in the practice

- for a grade: Submitting essay

**Summary of content – theory**

**lectures:**

1. Introduction. Classifications of analytical methods. Performance characteristics of the analytical methods. Selectivity, specificity. Robustness/ruggedness. Range of measurement. Linearity. Sensitivity. Detection limit. Quantitation limit. Accuracy. Precision, repeatability, reproducibility.

2. Chromatography. History of the chromatography. Extraction during chromatography. Chromatography. Terminology of the chromatography. Gas chromatography. Liquid chromatography. Paper chromatography. Thin-layer chromatography. General procedures of the thin layer chromatography. Factors affecting thin-layer separations. Column liquid chromatography. Supercritical fluid chromatography

3. Physicochemical principles of chromatographic separation. Adsorption (liquid-solid) chromatography. Partition (liquid-liquid) chromatography. Coated supports. Bonded supports. Ion exchange chromatography. Size-exclusion chromatography. Affinity chromatography. Analysis of chromatographic peaks. Chromatographic resolution. Qualitative analysis. Quantitative analysis. Summary of first part of chromatography.

4. The most frequently used chromatographic methods in the practice. High-performance liquid chromatography. Components of an HPLC system. Pumps. Injector. Column. Column hardware. HPLC column packing materials. Detector. Data stations systems. Normal phase HPLC. Stationary and mobile phases. Applications of normal-phase HPLC.

5. Reversed phase HPLC. Stationary and mobile phases. Applications of reversed-phase HPLC. Ion exchange chromatography. Stationary and mobile phases. Ion chromatography. Ion exchange chromatography of carbohydrates and proteins. Size-exclusion chromatography. Column packings and mobile phases. Applications of high performance SEC. Affinity chromatography. Summary of HPLC.

5. Gas chromatography. Sample preparation for gas chromatography, Isolation of solutes from food. Sample derivatization. Gas chromatographic hardware and columns. Gas supply system. Injection port. Oven. Column and stationary phases. Detectors.

6. Chromatographic theory. Separation efficiency. Applications of GC. Residual volatiles in packaging materials. Separation of stereoisomers. Headspace analysis of ethylene oxide in spices. Aroma analysis of heated butter. Total fat by GC for nutrition labelling. Summary of GC.

7. Specific analysis of mono- and oligosaccharides. High-performance liquid chromatography. Stationary phases. Detectors. Gas chromatography. Neutral sugars reduction to alditols. Hydrolyzates of polysaccharides containing uronic acids. Preparation and chromatography of trimethylsilyl (TMS) derivatives. Thin-layer chromatography.

8. Analysis of vitamins by chromatographic methods. Commonly used regulatory methods for vitamin analysis. Determination of vitamin A by HPLC. Determination of vitamin E (tocopherols, tocotrienols) by HPLC. Determination of the fatty acid composition of the fats. Determination of the fatty acid composition as fatty acid methyl esters.

9. Determination of volatile acids (volatile fatty acids) by gas chromatography. Determination of antioxidants. Determination of the amino acid content by gas chromatography. Determination of cholesterol and phytosterols. Separation of lipid fractions by TLC.

10. Protein separation and determination by chromatographic methods. Separation by adsorption. Ion-exchange chromatography. Affinity chromatography.

11. High-performance liquid chromatography. Separation by size. Size-exclusion chromatography.

12. Separation and determination of the amino acids by ion exchange column chromatography applying postcolumn derivatization. Introduction. Sample preparation. Hydrolysis of the protein. Performic acid oxidation before hydrolysis. Hydrolysis methods for the determination of tryptophan. Recent developments in the hydrolysis of the proteins.

13. Ion exchange chromatography of amino acids. Ion exchange resins. Buffer systems for separation of the amino acids. Recent developments in the chromatographic separation. Detection systems. The reaction of the amino acids with ninhydrin. The reaction of the amino acids with other reagents. Controlling of the apparatus and evaluation of the chromatograms. Summary of amino acid analysis.

14. Determination of the amino acids by precolumn derivatization with HPLC. Determination of the protein building amino acids by precolumn derivatization. Determination of D- and L-amino acids by high performance liquid chromatography. Mycotoxin analysis. Detection and determination of mycotoxins. Quantitative and confirmative chemical methods.

**Summary of content - practice**:

**practices:**

Practice 1.

1. Introduction to separation techniques

2. Adopting a new analytical method

3. Evaluation of analytical data

4. Determine the precision of the new method and compare it to the old method

5. Precision, accuracy and specificity of a method

6. Absolute error, relative error

7. Sensitivity and detection limit

8. Correlation coefficient, coefficient of determination

Practice 2.

9. Sampling and Sample Preparation

10. Equipment for collecting a representative sample for analysis

11. Sample bias, change in composition, metal and microbial contamination

Practice 3.

12. Protein Analysis

13. The steps of the Kjeldahl method

14. The conversion factor from Kjeldahl nitrogen

15. Nesslerization

16. Different techniques for the determination of the protein content

Practice 4.

17. Basic principles of chromatography; adsorption, partition, normal phase, reversed phase, cation and anion exchanger, external and internal standards, thin layer and column-liquid chromatography

18. Bonded support, coated support

19. Anion exchange column chromatography of the proteins

20. Size exclusion chromatography (SEC) for determination of the molecular mass of proteins

Practice 5.

21. Stationary phases for protein separation

22. The principle of affinity chromatography; spacer arm

23. Isocratic and gradient elution

24. Quantitate sample components

25. Internal standard, external standard

26. Differences between SFC and LC

Practice 6.

27. High performance liquid chromatography

28. Guard columns

29. Requirements of HPLC column packing materials

30. HPLC detectors

31. Stationary phase with a polar, nonionic functional group

32. HPLC analysis using a column packed with silica gel

33. HPLC and external standards

34. Ion chromatography in food analysis

35. Ion exchange and size exclusion chromatography

Practice 7.

36. Gas Chromatography

37. Solid phase extraction

38. Derivatization before GC analysis

39. Temperature of the injection port at GC analysis

40. Physical characteristics of packed and capillary columns

41. Rises of the baseline

Practice 8.

42. Differentiation between the GC detectors

43. Different separation methods for GC

44. Connection between efficiency and capacity

45. Using internal standard in GC

46. Compare the HPLC and GC chromatographic techniques for separation and determination of different food components

Practice 9.

47. Mass Spectrometry

48. Unique data an MS provide

49. EI and CI ionization

50. Base peak, molecular ion peak at MS

51. Major ions in the in the EI mass spectrum

52. Major differences between the different mass analysers

Practice 10.

53. Analysis of pesticide, mycotoxin, and drug residues in foods

54. Analytical methods provide only estimates

55. Multiresidue, single-residue, and screening methods

56. Five major steps in pesticide analysis

57. Pesticide, mycotoxin and drug residue analysis

58. Immunoassay based analytical methods

59. Microbiological assays for determination of mycotoxin contamination?

60. Sampling procedures for different analyses

61. Screening procedures for mycotoxin, pesticide and drug analysis

62. Mycotoxin analysis by mini-column, commercial kits and HPLC

Practice 11.

63. Vitamin Analysis

64. Extract the vitamins from foods

65. Microorganisms for quantitate vitamins

66. Niacin and folate determination

67. Fluorometric and titrimetric methods for vitamin C content determination

68. Vitamin C forms determination

69. Using HPLC for vitamin analysis

Practice 12.

70. Protein separation and characterization procedures

71. Separation of four different proteins from others

72. Compare the principles of SDS-PAGE and IEF

73. Differences between capillary electrophoresis and SDS-PAGE

Practice 13.

74. Characteristics of the proteins of interest

75. Determination of the amino acid composition of a soy protein

76. Cation exchange column chromatography for separation of amino acids

77. The amino acid profiles of protein supplements sold to body builders

78. Protein quality assay methods

79. Differences between protein quality assay procedures

80. Determine the protein quality of a snack food under various processing

Practice 14.

81. Carbohydrate Analysis

82. Determination of the sugars by GC

83. HPLC vs. GC for carbohydrate analysis

84. RI and PAD detectors in carbohydrate analysis

85. Separation of cellulose, water soluble gums and starch

**Literature, handbooks**

Kovács B – Csapó J.: Modern methods of food analysis. University of Debrecen, Faculty of Agricultural and Food Science and Environmental Managemenet. 2015. 1-205.

Nollett, L.M.L. – Toldra, F.: Food analysis by HPLC. CRC Press. Taylor & Francis Group. Boca Raton. 2013. 1-1033.

Anderson, J.L. – Berthod, A. – Pino Estevez, V. – Stalcup, A.M.: Analytical Separation sciences. Wiley-VCH Verlag GmbH &Co. KGaA. 2015. 1-1929.

Mondello. L. (Ed.): Comprehensive chromatography in combination with mass spectrometry. John Wiley & sons. Inc. 2011. 1-491.

Cruz, R.M.S. – Khmelinskii, I – Vieira, M.C.: Methods in food analysis. CRC Press, Taylor & Francis Group. Boca Raton. 2014. 1-250.

**Summer practice, MTMEL7GYA**

ECTS Credit Points: 0

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: signature

Requirements:

- for signature: Completion of the summer practice

- for a grade: Completing and submitting the documentation required for the practice

**Summary of content - practice**:

application of the theoretic and practical knowledge obtained during the study period while working for an enterprise / legal entity active in the food sector.

**Theory of measurement and experimental design, MTMEL7001A**

ECTS Credit Points: 5

28 hour(s) lecture and 28 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Submission of 2 essays, and the food prototype proof of concept

Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the lecturer. Active participation is evaluated by the teacher.

- for a grade: 2 essays on given topic, 2 presentations on given topic, Elaboration of a health-promoting food prototype proof of concept , Written and oral exam

**Name and code of the subject: Theory of measurement and experimental design, MTMEL7001A**

**Name and title of the person responsible for the subject:** Dr. Endre Máthé, associate professor PhD

**Additional instructors involved in teaching the subject: -**

**Name and level of the program:** Food safety and quality engineering MSc

**Subject type:** compulsary

**Teaching timetable of the subject, type of examination:** 2 lect. + 2 pract., oral

**Credit value of the subject:** 5

**Purpose of teaching the subject:**

Successful food development and quality control is based on the proper application of theory of measurement and experimental design. The students will become familiar with the STEM (Science-Technology-Engineering-Mathematics)-specific professional culture specificities and values. They will also learn about the logics STEM-type of research including the formulation of questions, definition of research object, elaboration and documentation of research activities, analysis of results, formulating the right conclusions and all these things together in the context of food development, quality control and food chain supply.

**Content of the subject (14 weeks):**

**LECTURES**:

1. The STEM- specific professional culture and values.

2-3. The STEM type of observation and research logics. The direct and indirect proofs type of research data.

4-5. Research publications types and their content, scientific writing style, ethical considerations.

6-7. Measurement of fundamental and derived properties, data collecting and interpreting. Presenting numerical data. Dimensions, units and equations.

8-9. Macro- and microscopic measurements techniques: mass-, volume- and cell number determination.

10-11. Research planning and implementation: choosing the right object to study, sample size allocation and the statistic method, documentation of observations and hypothesis analysis.

12-13. Analysis of research data: descriptive statistics and correlation analysis; publication of numerical data.

14-15. Food industrial applications: development of novel food prototypes based on quantitative and qualitative parameters. The EFSA and FDA.

**PRACTICALS**:

1. STEM specific informatics databases

2-3. Elaboration of research plans for food prototype development and quality assessment.

4-5. Scientific presentations and publications preparation based on the theoretical considerations related to the quality control of a developed food prototype.

6-7. Measurements based on calculi.

8-9. Determination of volume, mass and cell number in laboratory conditions.

10-13. Statistical analysis, problem solving.

14-15. Presentation of food prototype/quality concepts and evaluation.

**Type of mid-term examination:** participation in the practicals is mandatory. Attendance at 70% of the practicals is mandatory. In case of absence, a report must be submitted by the student within two weeks from the missed practice (theoretical and practical description).

Participation in the practicals is a precondition for the final exam.

**Method of assessment (semester examination mark - report, practical grade, colloquium, examination):** practical grade

**Teaching aids:** lecture specific PPTs, research/review papers

**Recommended literature:**

• Adams, D.S. (2003). Lab Math. A handbook of measurements, calculations and other quantitative skills for use at bench. Cold Spring Laboratory Press. Cold Spring Harbour, New York. ISBN 0-87969-634-6.

• Davis, M. (1996). Scientific papers and presentations. Academic Press. San Diego, London. ISBN: 0-12-206370-8.

• Lazic, Z. (2004). Design of experiments in chemical engineering. A practical guide. WILEY-VCH Verlag Gmbh, Wienhelm

• Leedy, PD , Ormrod, JE (2015).Practical Research: Planning and Design, Enhanced Pearson eText -- Access Card (11th Edition). Pearson Ltd., ISBN-13: 978-0133747188

• Gratzer, W. (2002). Eurekas and Euphorias. The Oxford book of scientific anecdotes. Oxford University Press, Oxford. ISBN: 0-19-280403-0.

**Traceability in the food chain, MTMEL7017A**

ECTS Credit Points: 3

14 hour(s) lecture and 14 hour(s) seminar per semester

Type of exam: written exam

Requirements:

- for signature: Participating in the exercises, Completing practical exercises, Submitting practical essays, Giving presentation

- for a grade: Three mid-year written exams, Written exam (if the result of the mid-year written exams is less than 60%)

The course ends in a mid-semester grade based on the result of the mid-year written exams. The minimum requirement for both mid-term and end-term written exams is 60%.

Result and grade:

0-59%: fail (1)

60-69%: pass (2)

70-79%: satisfactory (3)

80-89%: good (4)

90-100%: excellent (5)

If the result of the written exams is below 60%, it is necessary to rewrite that.

**Summary of content – theory**

The aim of the subject is the introduction of the standards, furthermore, the development, operation and certification of quality, environmental and food safety systems.

**lectures:**

1. Introduction. Definitions. The relationship between the food chain safety and traceability
2. Aims, significance and benefits of traceability
3. Types of tracing procedures and their characteristics
4. Regulations and standards related to food traceability
5. Follow-up systems in case of plant origin foods
6. Follow-up systems in case of animal origin foods
7. TIR and ENAR system
8. GS1 system and standards
9. Types of bar codes and their characteristics. RFID system

**Summary of content - practice**: Familiar with the follow-up techniques and their application in practice. Design and implement a traceability system.

**practices:**

1. Definitions, importance, objectives, types and principles of the traceability
2. Definitions, importance, objectives, types and principles of the traceability
3. GS1 system and standard
4. GS1 system and standard
5. Types and application of barcodes
6. Types and application of barcodes
7. Application of RFID technology in traceability
8. Application of RFID technology in traceability
9. Design and implementation of a traceability system

**Literature, handbooks**

Schiffers, B. (2011): Traceability. COLEACP-PIP programme, training manual 2. 118 p.

Regulation (Ec) No 178/2002 of The European Parliament and of The Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety

Commission Implementing Regulation (EU) No 931/2011 of 19 September 2011 on the traceability requirements set by Regulation (EC) No 178/2002 of the European Parliament and of the Council for food of animal origin

ISO 22005:2007. Traceability in the feed and food chain. General principles and basic requirements for system design and implementation.

The course consists of lectures and seminars. Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up a practice class with another group. The attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student’s behaviour or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

The knowledge of the students will be tested several times depending on the class types during the entire course. The training ends in a Final Exam (FE) of the whole semester material and a minimum of four FE dates will be set during the examination period. Unsuccessful students may repeat

During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

Tests are evaluated according to the followings:

Score Grade

0-59 fail (1)

60-69 pass (2)

70-79 satisfactory (3)

80-89 good (4)

90-100 excellent (5)

absence for any reason counts as 0%. If the score of any test is below 60, the student can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

An offered grade: It may be offered for the students if the average of the mid-term and end-term tests is at least good (4). The offered grade is the average of them.

# **Internship**

Students have to carry out a 4-week internship involved in the model curriculum. The internship course must be signed up for previously via the NEPTUN study registration system in the fall semester (3rd semester). Its execution is the criteria requirement of getting the pre-degree certificate (absolutorium).

# **Work and Fire Safety Course**

According to the Rules and Regulations of University of Debrecen a student has to complete the online course for work and fire safety. Registration for the course and completion are necessary for graduation. For MSc students the course is only necessary only if BSc diploma has been awarded outside of the University of Debrecen.

Registration in the Neptun system by the subject: MUNKAVEDELEM

Students have to read an online material until the end to get the signature on Neptun for the completion of the course. The link of the online course is available on webpage of the Faculty.

# **Physical Education**

According to the Rules and Regulations of University of Debrecen a student has to complete Physical Education courses at least in two semesters during the Bachelor training and one semester during the Master training. Our University offers a wide range of facilities to complete them. Further information is available from the Sport Centre of the University, its website: [http://sportsci.unideb.hu.](http://sportsci.unideb.hu/)

# **Thesis**

A Thesis is the creative elaboration of a professional task in written form. By solving the task, the student relies on his/her studies using national and international literature under the guidance of an internal and external supervisor (referee). By solving the task, the food safety and quality engineering student certifies that he/she is capable to apply the acquired knowledge in practice and to summarize the completed work and its results in a professional way, to solve the tasks related to his/her topic creatively and to complete individual professional work. By preparing and defending thesis students who complete the Food Safety and Quality Engineering graduate program prove that they are capable of the practical applications of the acquired skills, summarizing the work done and its results in a professional way, creatively solving the tasks related to the topic and doing individual professional work. The faculty academic calendar sets the thesis submission deadline.

A student in master program has to prepare a thesis as a prerequisite of the final exam. The requirements of the thesis content, the general aspects of evaluation and the number of credits assigned to the thesis are determined by the requirements of the program. In food safety and quality engineering program the credits assigned to the thesis is 25.

Thesis topics are announced by the departments for the students in each semester. A thesis topic can be suggested by the student as well and the head of department shall decide on its acceptance.

Thesis is evaluated by the referee, and it is evaluated and qualified individually by the department. The Head of the Department makes suggestion on its qualification to the Final Exam Board.

If the thesis is evaluated with a fail mark by the referee, and the student is not allowed to take the final exam and is supposed to prepare a new or modified thesis. The student has to be informed about it. Conditions on resubmitting the thesis are defined by the program coordinator.

# **Final examination (Final Exam)**

Students having obtained the pre-degree certificate will finish their studies by taking the final exam. Final exam can be taken in active student status in the forthcoming exam period after gaining the pre-degree certificate then after termination of student status in any exam period within two years according to the valid education requirements. After the fifth year of the termination of student status the candidate is not allowed to take the final exam. Only students who do not have outstanding charges are allowed to take the final exam. (E.g.: Students who obtained a pre-degree certificate until 1 September 2020 can take the final exam until 1 September 2022.)

A student having obtained the pre-degree certificate (absolutorium) will finish his/her studies training by taking the final exam. A final exam is the evaluation and control of the knowledge and skills acquired in tertiary education during which the candidate has to certify that he/she is able to apply the obtained knowledge in practice.

A final exam can be taken in the forthcoming exam period after obtaining the pre-degree certificate. The Department announces two final exam dates in a year, one at the beginning of January and one at the end of June. A final exam has to be taken in front of the Committee on the fixed date. If a candidate does not pass his/her final exam by the termination of his/her student status, he/she can take his/her final exam after the termination of the student status on any of the final exam days of the relevant academic year according to existing requirements on the rules of the final exam.

The Final exam consists of two parts according to the curriculum.

1. Written and oral exam on the given topics.
2. Thesis Defence (a presentation of the thesis, answering questions, comments then answering questions based on the knowledge related to the thesis topic)

A final exam can be started if the candidate can be submitted to the final exam on the basis of definite opinion of the referees. The two parts must be held on the same day.

The parts of the final exam are evaluated on a five-point scale by members with voting rights in the Final Exam Board. The final grade for the final exam will be decided on by voting in a closed sitting after the final exam, then. In case of equal votes, the committee chair will make the decision. Final exam results will be announced by the committee chair. Results of the final exam and thesis defence will be announced at the end of the given exam day (when all candidates finished final exam and thesis defence on the given day). A note of the final exam will be taken.

*Improving failed final exam*

If a thesis is evaluated with a fail mark by the Final Exam Board a final exam has to be retaken with a new or modified thesis.

If any of part if the final exam is a fail it must be retaken according to the existing rules of the university. Final exam can be retaken twice. The ensuing final exam period is the soonest that the re-sit is allowed.

*Final exam board*

Committee chair and members of the committee are called upon and mandated by the dean with the consent of the Faculty Council. They are selected from the acknowledged internal and external experts of the professional field. Traditionally, it is the chair and in case of his/her absence or indisposition the vice-chair who will be called upon, as well. The committee consists of – besides the chair – at least one member (a professor, an associate professor or college professor) and at least two questioners (instructors) and the examiner. In controversial cases the chair makes the decision. The mandate of a Final Examination Board lasts for three years. The division of the candidates to the mandatory final exam board is announced by the Registry Office.

# **DIPLOMA**

Within 30 days of the successful final exam the diploma is issued and given out by the Faculty at the graduate’s special request. Otherwise, the diploma will be awarded to him/her at the graduation ceremony of the Faculty.

The diploma is an official document decorated with the coat of arms of Hungary which verifies the successful completion of studies in the Food Safety and Quality Engineering graduate program. The diploma contains the following data: name of HEI (higher education institution); institutional identification number; serial number of diploma; name of diploma holder; date and place of his/her birth; level of qualification; training program; specialization; mode of attendance; place, day, month and year issued. Furthermore, it has to contain the dean’s (or vice-dean’s) original signature and the seal of HEI. It has to contain the dean’s (in case of being prevented from attending the vice- dean for educational affairs) original signature and the imprint of the official stamp of the tertiary institute.

At the graduate’s special request a certificate on the completion of studies is issued. The document does not contain any reference to qualification, it merely proves that the candidate has taken a successful final exam. The Faculty keeps a record of the certificates issued.

Calculation of a diploma grade according to this formula:

The qualification of the diploma is the simple arithmetic average results of the weighted academic average of all semesters of the given training, the result of the oral complex final exam, and the thesis.

Grade=(A+B+C)/3, where  
A: Weighted academic average of all semesters of the given training

B: Grade of the oral complex final exam  
C: Grade awarded for defending the thesis

On the basis of the calculated average grade the classification of the award: Outstanding 4,81 – 5,00

Excellent 4,51 – 4,80

Good 3,51 – 4,50

Satisfactory 2,51 – 3,50

Pass 2,00 – 2,50

Award with Honour

An Award with Honour is permitted where a student obtained grade 5 in all subjects of the final exam. The average of thesis grade, his/her exam grades and mid-semester grades during his/her studies is at least 4.00. Moreover, he/she is not permitted to have a grade worse than grade 3 during his/her studies.

**MODEL CURRICULUM OF FOOD SAFETY AND QUALITY ENGINEERING MSC**

The curriculum of the program is available in excel format on the webpage of the Faculty of Agricultural and Food Sciences and Environmental Management:

(https://mek.unideb.hu/en/food-safety-and-quality-engineering).

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|  | *Head of Program: Dr. Kovács Béla, university professor* | | | | | | | | | | | | | | | | | | | | |
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| **Code** | Subject | | | | **I. semester** | | | | **II. semester** | | | | **III. semester** | | | | **IV. semester** | | | | Responsible lecturer for the course |
| 14 | | | | 14 | | | | 14 | | | | 14 | | | |
| pre | pra | e | cr | pre | pra | e | cr | pre | pra | e | cr | pre | pra | e | cr |
|  | ***Basic subjects*** | | | | | | | | | | | | | | | | | | | |  |
| MTMEL7001A | Theory of measurement and experimental designs | | | | 2 | 2 | C | 5 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Máthé Endre |
| MTMEL7002A | Expectations to foodstuffs, consumer protection | | | | 1 | 1 | C | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Czipa Nikolett |
| MTMEL7003A | Separation technique | | | | 2 | 2 | P | 5 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Csapó János |
| MTMEL7004A | Quality and safety in food technologies (HACCP in practice) | | | | 2 | 1 | C | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Czipa Nikolett |
| MTMEL7005A | Food marketing | | | | 2 | 1 | C | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Polereczki Zsolt |
| MTMEL7006A | Basics of food microbiology | | | | 2 | 0 | C | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Karaffa Erzsébet |
| MTMEL7007A | Management and communication | | | | 2 | 0 | C | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Juhász Csilla |
|  | ***Total number of lessons:*** | | | | 13 | 7 | 25 | |  |  |  | |  |  |  | |  |  |  | |  |
| MTMEL7008A | Spectroscopyc methods | | | |  |  |  |  | 2 | 2 | P | 5 |  |  |  |  |  |  |  |  | Dr. Kovács Béla |
| MTMEL7009A | Nutritional sciences | | | |  |  |  |  | 2 | 0 | C | 3 |  |  |  |  |  |  |  |  | Dr. Csiki Zoltán |
| MTMEL7010A | Essential molecular cell biology | | | |  |  |  |  | 2 | 2 | C | 4 |  |  |  |  |  |  |  |  | Dr. Máthé Endre |
| MTMEL7011A | Microbiological aspects of food quality and safety | | | |  |  |  |  | 2 | 2 | P | 4 |  |  |  |  |  |  |  |  | Dr. Karaffa Erzsébet |
| MTMEL7012A | Quality control, quality management | | | |  |  |  |  | 2 | 1 | C | 4 |  |  |  |  |  |  |  |  | Dr. Pusztahelyi Tünde |
|  | ***Total number of lessons:*** | | | |  | | | | 10 | 7 | 20 | |  |  |  |  |  |  |  |  |  |
| MTMEL7013A | Regulation of food production, quality and safety | | | |  |  |  |  |  |  |  |  | 3 | 0 | C | 3 |  |  |  |  | Dr. Andorkó Imre |
| MTMEL7014A | Food toxicology | | | |  | | | |  |  |  |  | 2 | 2 | C | 4 |  |  |  |  | Dr. Prokisch József |
| MTMEL7015A | Hyphenated analytical methods | | | |  | | | | | | | | 1 | 1 | C | 3 |  |  |  |  | Dr. Béni Áron |
| MTMEL7016A | Quality management systems and audit in the food chain | | | |  |  |  |  |  |  |  |  | 2 | 2 | C | 4 |  |  |  |  | Dr. Peles Ferenc |
| MTMEL7017A | Traceability in the food chain | | | |  |  |  |  |  |  |  |  | 1 | 1 | C | 3 |  |  |  |  | Dr. Peles Ferenc |
| MTMEL7018A | Food industry management and economics | | | |  | | | | | | | | 2 | 1 | C | 3 |  |  |  |  | Dr. Buzás Ferenc Ede |
|  | ***Total number of lessons:*** | | | |  |  |  | |  |  |  | | 11 | 7 | 20 | |  |  |  | |  |
| MTMEL7019A | Radiology in food industry | | | |  |  |  |  |  |  |  |  |  |  |  |  | 2 | 1 | C | 3 | Dr. Prokisch József |
| MTMEL7020A | Analytical and microbiological rapid methods | | | |  | | | | | | | |  |  |  |  | 2 | 2 | P | 4 | Dr. Karaffa Erzsébet, Dr Prokisch József |
| MTMEL7021A | Food quality and safety risk analysis | | | |  | | | | | | | |  |  |  |  | 3 | 2 | C | 5 | Dr. Czipa Nikolett |
| MTMEL7022A | Rheology in food testing | | | |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 1 | C | 3 | Dr. Kovács Béla |
|  | ***Total number of lessons:*** | | | |  |  |  | |  |  |  | |  |  |  | | 8 | 6 | 15 | |  |
| MTMEL7GYA | ***Summer practice\**** | |  |  |  |  |  |  | 0 | 160 | A | 5 |  |  |  |  |  |  |  |  | Dr. Stündl László |
|  | Physical education | |  |  |  |  |  |  | 0 | 2 | A | 0 |  |  |  |  |  |  |  |  |  |
|  | ***Optional subjects*** | | | | | | | | | | | | | | | | | | | |  |
| MTMEL7023A | Environmental aspects of food processing | | | | 3 | 0 | C | 4 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Tamás János |
| MTMEL7024A | Extension knowledge | | | | 2 | 0 | C | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Pető Károly |
| MTMEL7025A | Medicinal plants and their processing | | | | 1 | 2 | C | 4 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Kutasy Erika |
| MTMEL7026A | Quality control of biological bases | | | | 2 | 0 | C | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Pepó Péter, Dr. Rózsáné Dr. Várszegi Zsófia |
| MTMEL7027A | Biochemical bases of products quality | | | | 2 | 0 | C | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Vágó Imre |
| MTMEL7028A | The management of value creating processes in the food industry | | | | 1 | 1 | C | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Buzás Ferenc Ede |
| MTMEL7029A | Quality evaluation of food proteins | | | | 2 | 0 | C | 3 |  |  |  |  |  |  |  |  |  |  |  |  | Dr. Remenyik Judit |
| MTMEL7030A | Packaging technology | | | |  |  |  |  | 2 | 0 | C | 3 |  |  |  |  |  |  |  |  | Dr. Kovács Béla |
| MTMEL7032A | Biosensors and nanotechnology | | | |  |  |  |  | 2 | 2 | C | 4 |  |  |  |  |  |  |  |  | Dr. Prokisch József |
| MTMEL7033A | Food safety assessment of agrochemicals |  |  |  |  |  |  |  | 2 | 0 | C | 3 |  |  |  |  |  |  |  |  | Dr. Remenyik Judit |
| MTMEL7034A | Molecular biology methods for food authentication | | | |  |  |  |  | 1 | 1 | C | 3 |  |  |  |  |  |  |  |  | Dr. Czeglédi Levente |
| MTMEL7035A | Molecular background of animal product quality | | | |  |  |  |  |  |  |  |  | 1 | 0 | C | 3 |  |  |  |  | Dr. Czeglédi Levente |
| MTMEL7036A | Innovation management | | | |  |  |  |  |  |  |  |  | 1 | 1 | C | 3 |  |  |  |  | Dr. Gályász József |
| MTMEL7037A | Nutritional genetics and genomics | | | |  |  |  |  |  |  |  |  | 2 | 2 | C | 4 |  |  |  |  | Dr. Máthé Endre |
| MTMEL7038A | Food logistics | | | |  |  |  |  |  |  |  |  | 1 | 2 | C | 4 |  |  |  |  | Dr. Pakurár Miklós |
| MTMEL7039A | Proteomics in food production | | | |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 1 | C | 3 | Dr. Czeglédi Levente |
| MTMEL 7041A | Chemometry | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 1 | C | 3 | Dr. Elek János |
|  | **\* 10 credits are compulsory** | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  |  | | | |  | | | | | | | | | | | | | | | |  |
|  | **Dissertation** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MTMEL7D1A | Dissertation I. | | | |  |  |  |  | 0 | 2 | P | 5 |  |  |  |  |  |  |  |  |  |
| MTMEL7D2A | Dissertation II. | | | |  | | | | | | | | 0 | 2 | P | 10 |  |  |  |  |  |
| MTMEL7D3A | Dissertation III. | | | |  | | | | | | | | | | | | 0 | 2 | P | 10 |  |
|  | ***Total number of lessons:*** | | | | 13 | 7 | 25 | | 10 | 9 | 30 | | 11 | 9 | 30 | | 8 | 8 | 25 | |  |
|  | *Credits for compulsory subjects* | | | | 25 | | | | 25 | | | | 20 | | | | 15 | | | | 85 |
|  | *Credits for optional subjects* | | | |  | | | |  | | | |  | | | |  | | | | 10 |
|  | *Dissertation* | | | | 0 | | | | 5 | | | | 10 | | | | 10 | | | | 25 |
|  | **Total credit** | | | |  | | | |  | | | |  | | | |  | | | | 120 |
|  | **Number of lessons** | | | | 280 | | | | 266 | | | | 280 | | | | 224 | | | |  |
| \* Summer practice should spend at a plant or institute which dealing with food production or food testing. | | | | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Topics of final exam: analytics, food microbiology, quality management, food safety | | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |