**MASTER’S DEGREE IN FOOD ENGINEERING**

**1st SEMESTER**

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| **COURSE CODE**  | **NAME OF SUBJECT** | **STATUS** | **T** | **A** | **C** | **ECTS** |
| FBE-500 | Planning and Organizing Experiments, Processing Data | R | 3 | 0 | 3 | 3 |
| Science and its related concepts, research protocol, subjects, hypotheses, and basic research projects. Selecting and planning an experiment. Measurement and picking instruments for measuring. Methods of checking the accuracy of instruments. Preparing reports about research. Ethical questions in research.  |
| SBE-500 | Philosophy of Science | R | 0 | 3 | 0 | 3 |
| This course covers philosophy as a social phenomenon, and finds its reflection through the prism of a philosophical worldview. Also covered are the classification of science and the history of various divisions of science, and theoretical ideas that are studied in accordance with a modern philosophical perspective.  |
| GMÜ- 505 | Business Foreign Language  | R | 1 | 2 | 2 | 5 |
| This class is designed to improve student’s professional English language. Includes skills such as reading, comprehension, translation, and professional language.  |
| EĞT-570 | Teaching and Psychology of Higher Education | R | 2 | 0 | 0 | 5 |
| The social and cultural imperatives of higher education; goals, content and functions of education; form and methods of study; psychological features of students; planning and managing educational processes in higher education; higher education as the base of continued education and its roles.  |
| FBE- 502 | Introduction to Mathematical Programming | R | 3 | 0 | 3 | 3 |
| Basics of game theory; saddle points; payment matrixes; strategies; extreme challenges; special classes of problems in linear programming; solving methods; decision theory. |
| FBE- 503 | Mathematical Engineering | R | 3 | 0 | 3 | 4 |
| Introduction; formulating engineering tasks; linear equations, matrixes and determinants, linear systems, nonlinear systems, numerical analysis; simple differential equations, differential equations of the first type, the second type, and higher types, solving simple differential equations; Laplace transform, systems of simple differential equations; complex differential equations, their characteristics, uniting their variables, converting their integrals, and numerical analysis.  |
| FBE- 504 | Transport Phenomena of Substances | R | 3 | 0 | 3 | 4 |
| Microscopic and macroscopic equilibrium during impulse transfer, both energy and mass. Classification of liquids; coefficients of transfer, transfer of impulses and distribution of speeds; energy change for isothermal systems, velocity distribution for smooth and rough pipes and friction factors; transport phenomena in phases, shift phenomena of unstable modes with chemical reactions.  |
|  | Elective Course | E | 1 | 2 | 2 | 3 |

\* R: Required Course, E: Elective course, T: Theoretical A: Applied, C: Credits

**2ND SEMESTER**

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| **COURSE CODE**  | **NAME OF SUBJECT** | **STATUS** | **T** | **A** | **C** | **EKTS** |
| GMÜ-512 | Seminar | R | 0 | 3 | 0 | 0 |
| Students organize seminars on their dissertation themes (literature review and scientific research). |
| GMÜ-514 | High-Technology Food Production | R | 2 | 0 | 2 | 5 |
| Covers questions related to the implementation of high-tech food production for functional and specialized purposes based on the implementation of nano- and biotechnology, membrane methods of processing to ensure the safety of food products through the implementation of HACCP systems during productions.  |
| GMÜ-516 | Microbiology and Epidemiology in Food Engineering | R | 1 | 2 | 2 | 5 |
| Recent studies on morphology and the physiology of microorganisms. Pathogens and their danger to the health of humans. The microbiology of milk and milk products, meat and meat products, eggs and egg products, fish and fish products, as well as flour and grains. Microbiology of fruits and vegetables, and preserves. Microbiological and sanitary criteria to ensure food safety through HACCP systems.  |
| GMÜ-518 | Modern Research Methods for Studying Raw Products and Food Products | R | 2 | 2 | 3 | 5 |
| Modern methods for integrated quality testing and ensuring the safety of raw materials and food products. Studying nutritional values and the safety of raw products and prepared food products. Studying physical, physical-chemical, and structural-mechanic properties of food products. Electrochemical and radiometric methods for studying raw materials and food products. Biochemical properties and transformation of animal and vegetable tissues. Determining contaminants in food products.  |
| GMÜ-520 | Information Technology in Controlling the Quality of Raw Materials and Food Products | R | 3 | 0 | 3 | 5 |
| Quality control in food production facilities. General information about quality control systems that comply with ICO 9000. ICO 9000 and informational enterprises. Information systems and enterprises. Methods for automatizing the control of organizational systems. Laboratory and informational systems in food enterprises. Information technology in modeling food enterprises. Using information to control quality during production and in controlling production and enterprises. Automatizing tasks done in laboratories. Possibilities of laboratory-controlled systems. Using computer programs for modeling and reconstructing food enterprises.  |
|  | Elective Course | E | 1 | 1 | 2 | 4 |
|  | Elective Course | E | 1 | 1 | 2 | 4 |

\* R: Required Course, E: Elective course, T: Theoretical A: Applied, C: Credits

**3RD SEMESTER**

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| --- | --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **STATUS** | **T** | **A** | **C** | **ECTS** |
| GMÜ- 530 | Master’s Dissertation | R | 0 | 1 | 0 | 25 |
| Master’s dissertation is completed under the guidance of an advisor. Students work on their dissertations in the third and fourth semesters.  |
| GMÜ- 500 | Research Practicum | R | 0 | 2 | 0 | 2 |
| Research practicum in leading institutions. |
| GMÜ- 511 | Teaching Practicum | R | 1 | 2 | 0 | 3 |
| Students lead practical and laboratory classes as assistants and attend lectures led by professors and assistant professors.  |

\* R: Required Course, E: Elective course, T: Theoretical A: Applied, C: Credits

**4TH SEMESTER**

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| **COURSE CODE**  | **NAME OF SUBJECT** | **STATUS** | **T** | **A** | **C** | **ЕKTС** |
| GMÜ- 530 | Master’s Dissertation | R | 0 | 1 | 0 | 10 |
| Master’s dissertation is completed under the guidance of an advisor. Students work on their dissertations in the third and fourth semesters. |
| GMÜ- 501 | State Exam According to Specialty | R | 0 | 0 | 0 | 5 |
| Final state exam in the student’s specialty.  |
| GMÜ- 501.1 | Defense of Master’s Dissertation | R | 0 | 0 | 0 | 15 |
| Defense of Master’s dissertation as part of state accreditation programs.  |

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**ELECTIVE COURSES**

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| --- | --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **STATUS** | **T** | **A** | **C** | **ECTS** |
| GMÜ- 532 | The Physiology of Food | E | 1 | 2 | 2 | 4 |
| Physiological systems related to food, digestion and the functions of the digestive system. Processes of utilizing food products and energy exchanges in the organism. Physiological importance of proteins, carbohydrates, fats, and vitamins. General principles of a healthy and balanced diet.  |
| GMÜ- 534 | The Engineering of Bioprocesses | E | 1 | 2 | 2 | 4 |
| Basic understandings of the engineering of bioprocesses. Material and energy balances in stable and unstable states. Physical processes; the flow and mixing of liquids; rheology of liquids, viscosity, mixing gassy liquids, scaling devices. Heat transfer; calculation of the heat transfer coefficient in a fermenter, the increase in dissipation with the increasing of volume of a chamber; processes of heating and cooling in a fermenter. Mass transfer; calculating the amount of oxygen consumed in aerobic cultures, correlating mass transfer, measuring the amount of oxygen in fermenters. The main processes in fermentation; mechanical separation, extraction, cell disruption (sonication), chromatography. Homogeneous and heterogenous reactions during fermentation, the fermentation processes; ideal reactors, periodic and half periodic properties and continuous fermentation, sterilization.  |
| GMÜ- 536 | Industrial Microbiology | E | 1 | 2 | 2 | 4 |
| The history and development of industrial microbiology. General properties of microorganisms used in industrial microbiology. General principles of regulated growth and the metabolism of microorganisms. Microbiological processes in the production of proteins, yeast, amino acids, nucleotides, vitamins, enzymes, antibiotics, wine, beer, alcoholic drinks, and genetically modified products.  |
| GMÜ- 538 | Spectrometric Methods of Analysis | E | 1 | 2 | 2 | 4 |
| The basic principles of spectroscopy, instrumental and spectral analysis, different means of spectroscopy; fluorescent and infrared spectroscopy, studying quality and properties of food and possible applications, hyperspectral and multispectral images, methods of analysis and enhanced data.  |
| GMÜ- 540 | Equipment of Food Production | E | 1 | 2 | 2 | 4 |
| Equipment for preparing raw materials, machines and apparatuses for processing food products, apparatuses for packing, automation. Researched aimed at creating sketches.  |
| GMÜ- 542 | Heat Processes in Food Production | E | 1 | 2 | 2 | 4 |
| Modeling two-dimensional heat transfer in steady and unsteady modes. Pasteurization, sterilization, freezing, etc. Modeling thermal processes and methods of solving related equations. Studying the process of pasteurization and sterilization using F and J factors. Experimental and theoretical approaches.  |
| GMÜ- 543 | Numerical Analysis in Heat Processes of Food Production | E | 1 | 2 | 2 | 3 |
| Introduction to numerical analysis. Analysis of units and their usage in heat exchange problems. Classification of complex differential equations. Implicit, explicit and the Crank-Nicolson Method. Parabolic equations. Numerical analysis of heat transfer in one direction in unstable regime. Numerical study of freezing and thawing. Computer programs. Two-dimensional heat exchange. Convection limit condition. Iterative methods. Elliptical equations. Introduction to methods of limiting elements.  |
| GMÜ- 544 | Electrophysical Methods of Processing Food Products | E | 1 | 2 | 2 | 4 |
| Electronic properties of products. Processing food products through electrophysical methods. Quality assessment of food processed through electrophysical methods. Perspectives of applying electrophysical methods in food engineering.  |
| GMÜ- 546 | Advanced Technology for Meat Products | E | 1 | 2 | 2 | 4 |
| Meat as a food product. Structure and properties of muscle fibers. Mechanisms of muscle reduction. Glycolysis and other factors that influence the conversion of muscle to meat. Properties of fresh meat. Basic methods for processing meat: boiling, roasting, conserving, smoking, emulsifying and fermenting meat products.  |
| GMÜ- 547 | Advanced Monitoring and Control Processes | E | 1 | 2 | 2 | 3 |
| Introduction to digital control systems, identification and classification, preventative control and strategy, methods of forecasting parameters, defining processes, deterministic and stochastic systems, self-regulating control systems, model control devices, built-in control devices, adopting predictive control.  |
| GMÜ- 550 | Technology for Processing Poultry | E | 1 | 2 | 2 | 4 |
| Introduction to technology for processing poultry. Chemical composition of poultry. Slaughtering, storing and freezing methods. Quality indicators and methods for improving quality. Converting muscles to meat. Methods for processing poultry: boiling, roasting, preserving, smoking, emulsifying, and fermenting poultry products. Technology for grinding poultry to make products. Additives used in these products. Special methods for preparing food and preparing products out of poultry.  |
| GMÜ- 552 | Chromatographic Methods for Analyzing Food Products | E | 1 | 2 | 2 | 4 |
| Gas chromatography (GC): parameters of the working columns, choosing the columns, the Kovats retention index, McReynolds constants, making a differential assessment of chromatograms, capillary columns, detectors, problems encountered in gas chromatography and their solutions, applications of gas chromatography in food analysis. High performance liquid chromatography (HPLC): columns and their materials, detectors, absorption, chromatography, ion exchange, size exclusion, ligand exchange chromatography. Problems and solutions in HPLC, applications of HPLC in food analysis. Supercritical fluid chromatography (SFC): principles and applications of SFC. Thin layer chromatography (TLC) and its uses in food analysis. Column chromatography (CC): types of CC and applications in food analysis. Paper chromatography (PC) and applications in food analysis.  |
| GMÜ- 554 | Rheological Methods in Engineering | E | 1 | 2 | 2 | 4 |
| Theories of rheological research from experiments and defining rheological properties of food products. Tension and deformation of solid and liquid substances. Tubular and cylindrical viscometers. Extensional flow. Studies of viscosity and elasticity.  |
| GMÜ- 556 | Technology for Processing Seafood | E | 1 | 2 | 2 | 4 |
| Chemical composition, quality parameters and nutritional values of fish and other seafood products. Changes in the quality of meat after death and effects of rigor mortis on quality. Processing seafood products en route through freezing, salting, drying, conserving and smoking. Microbiology of seafood and toxins in seafood products. Packaging methods.  |
| GMÜ- 558 | New Packaging Technologies | E | 1 | 2 | 2 | 4 |
| General principles and the function of packaging. Smart labels and RFID systems, smart packaging, the technology of active packaging, biodegradable packaging (biopolymers), edible film, technology of packing in regulated gas areas. Applications of these technologies. Advantages and disadvantages of new packaging technology as compared to traditional technologies.  |
| GMÜ- 560 | Eggs and the Technology of Egg Products | E | 1 | 2 | 2 | 4 |
| Detailed compositions and structures of eggs. Chemistry of eggs and egg products. Eggs and their nutritional value. The qualities of eggs and protecting eggshells. Processing eggs and egg products. Freezing, pasteurizing, preliminary sugar and dehydration steps. Quality and function of egg products. Packaging egg products.  |
| GMÜ- 570 | Special Topics in Food Engineering | E | 1 | 2 | 2 | 4 |
| Subjects not outlined in the course catalog. Topics change every year depending on the wishes of the students and professors.  |

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 Programs are carried out in line with the credit system outlined in the table (ECTS – the European Credit Transfer System) and conform with requirements to transfer to the European system.

**PhD IN FOOD ENGINEERING**

**1ST SEMESTER**

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| --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **T** | **A** | **C** | **ECTS** |
| GMÜ-601 | **Philosophy of Science**The philosophy of science, one of the founding disciplines of philosophy, answers fundamental questions about epistemology, scientific discoveries, and justifications. This course covers several different points of view in science, including what are the goals of science and what scientists say about their works. The works of Thomas Kuhn and other philosophers will also be discussed.  | 0 | 3 | 0 | 4 |
| FBE-602 | **Research Methods**Science and its related concepts, such as the research process and methodology, types of research, hypotheses, and research principles. Designing samples. Measuring and choosing instruments. Methods for testing the accuracy and reliability of measurements. Preparing reports about research. Ethical considerations in research.  | 3 | 0 | 3 | 4 |
|  | Elective Course | 3 | 0 | 3 | 5 |
|  | Elective Course | 3 | 0 | 3 | 5 |
|  | Elective Course | 3 | 0 | 3 | 6 |
|  | Elective Course | 3 | 0 | 3 | 6 |
|  |  |  |  |  |  |
| **TOTAL** |  | 15 | 3 | 15 | **30** |

T: Theoretical A: Applied, C: Credits

**2ND SEMESTER**

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| --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **T** | **A** | **C** | **ECTS** |
| GMÜ-604 | Seminar | 0 | 3 | 0 | 4 |
|  | Elective Course | 3 | 0 | 3 | 6 |
|  | Elective Course | 3 | 0 | 3 | 6 |
|  | Elective Course | 3 | 2 | 4 | 7 |
|  | Elective Course | 3 | 2 | 4 | 7 |
|  |  |  |  |  |  |
| **TOTAL** |  | 12 | 3 | 14 | **30** |

**ELECTIVE COURSES**

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| --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **T** | **A** | **C** | **ECTS** |
| GMÜ-631 | **Quality Management in Food Production**The philosophy and importance of general quality management in food production. Instruments, methods and their application; the general distribution of quality, continuous improvement, statistical quality control. Applications of HACCP in dairy, fermented, and meat production and in the production of drinks. General quality control in the production of new food products.  | **3** | **0** | **3** | **6** |
| GMÜ-633 | **Non-Thermal Methods of Processing in Food Production**The principles of non-thermal methods of processing in food engineering. High hydrostatic pressure (HHP), impulse electric field (IEP), pulsing lights and the use of ozone. Theories of engineering systems and their influence on microbiological, structural and biochemical food systems. Defining quality and shelf life.  | **3** | **0** | **3** | **5** |
| GMÜ-635 | **Food Additives, Pollutants, and Toxicology**Intentional and unintentional food additives, natural toxic components of plant and animal origin. Mycotoxins, detoxification, packaging materials and contamination, food-drug interactions, residue analysis of contaminants in food.  | **3** | **0** | **3** | **5** |
| GMÜ-636 | **Advanced Course in the Processes of Biological Engineering**Chromatography, adsorption, ion exchange, extrusion, membrane processes, dielectric heating, preserving food products through radiation.  | **3** | **2** | **4** | **7** |
| GMÜ-638 | **Advanced Course in Food Microbiology**Interactions of microorganisms in food products and their role in the spoilage of products, as well as biotechnology. Bacterial sporulation, germination, and the physiological properties of spores and the safety of food products.  | **3** | **2** | **4** | **7** |
| GMÜ-639 | **The Technology of Ready-Made Food Products**New sources of proteins, fats, and carbohydrates. Unicellular proteins, hydrolyzed vegetable proteins, synthetic scents; the division, cleaning and texturizing of new protein products.  | **3** | **0** | **3** | **6** |
| GMÜ-640 | **Microwave Processing of Food Products**The principles of microwave heating. Microwave processing: drying, baking, and blanching; freezing, sterilizing and cooking food. Modeling microwave heating. Developing products fit for microwave ovens.  | **3** | **0** | **3** | **6** |
| GMÜ-642 | **Advanced Course in Food Biochemistry**Proteins and enzymes focused on advanced food chemistry. Protein interactions and their influence on chemical and physical properties. Fermented medications and their clinical properties and applications.  | **3** | **0** | **3** | **6** |
| GMÜ-670 | **Special Topics in Food Engineering**Courses not mentioned in the catalog. The content of the course changes depending on the interests of the students and instructors.  | **3** | **0** | **3** | **5** |

**3RD SEMESTER**

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| --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **T** | **A** | **C** | **ECTS** |
| GMÜ- 610 | Qualifying Exam | 2 | 0 | 0 | 30 |
| **TOTAL** |  |  |  |  |  |

**4TH SEMESTER**

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| --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **T** | **A** | **C** | **ECTS** |
| GMÜ- 620 | Preparation for and taking of exams based on student’s dissertation subject. | 0 | 2 | 0 | 30 |
| **TOTAL** |  |  |  |  |  |

**5TH SEMESTER**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **T** | **A** | **C** | **ECTS** |
| GMÜ- 629 | Specialized Course | 0 | 1 | 0 | 12 |
| GMÜ- 630 | **Ph.D. Dissertation**Original research leading to the PhD degree. Students must take this course every semester, starting in the fifth semester.  | 2 | 0 | 0 | 18 |
| **TOTAL** |  |  |  |  |  |

**6TH SEMESTER**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **T** | **A** | **C** | **ECTS** |
| GMÜ- 629 | Specialized Course | 0 | 1 | 0 | 12 |
| GMÜ- 630 | **Ph.D. Dissertation**Original research leading to the PhD degree. Students must take this course every semester, starting in the fifth semester. | 2 | 0 | 0 | 18 |
| **TOTAL** |  |  |  |  |  |

**7- ПОЛУГОДИЕ**

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| --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **T** | **A** | **C** | **ECTS** |
| GMÜ- 629 | Specialized Course | 0 | 1 | 0 | 12 |
| GMÜ- 630 | **Ph.D. Dissertation**Original research leading to the PhD degree. Students must take this course every semester, starting in the fifth semester. | 2 | 0 | 0 | 18 |
| **TOTAL** |  |  |  |  |  |

**8- ПОЛУГОДИЕ**

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| --- | --- | --- | --- | --- | --- |
| **COURSE CODE**  | **NAME OF SUBJECT** | **T** | **A** | **C** | **ECTS** |
| GMÜ- 629 | Specialized Course | 0 | 1 | 0 | 12 |
| GMÜ- 630 | **Ph.D. Dissertation**Original research leading to the PhD degree. Students must take this course every semester, starting in the fifth semester. | 2 | 0 | 0 | 18 |
| **TOTAL** |  |  |  |  |  |

T: Theoretical A: Applied, C: Credits

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